US011976802B2

(12) **United States Patent**
LaVigna et al.

(10) **Patent No.: US 11,976,802 B2**
(45) **Date of Patent: May 7, 2024**

(54) **MODULAR LED LIGHT STRUCTURE**

(71) Applicant: **HKC-US, LLC**, Memphis, TN (US)

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(73) Assignee: **HKC-US, LLC**, Memphis, TN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **17/948,992**

(22) Filed: **Sep. 20, 2022**

(65) **Prior Publication Data**

US 2023/0332752 A1 Oct. 19, 2023

Related U.S. Application Data

(60) Provisional application No. 63/333,430, filed on Apr. 21, 2022, provisional application No. 63/330,560, filed on Apr. 13, 2022.

(51) **Int. Cl.**
F21S 8/00 (2006.01)
F21S 2/00 (2016.01)
(Continued)

(52) **U.S. Cl.**
CPC ***F21S 8/035*** (2013.01); ***F21S 2/005*** (2013.01); ***F21V 5/00*** (2013.01); ***F21V 29/70*** (2015.01); *F21Y 2115/10* (2016.08)

(58) **Field of Classification Search**
CPC ... F21S 8/035; F21S 2/005; F21S 8/03; F21V 5/00; F21V 29/70; F21V 21/03; F21V 17/14; F21V 17/16; F21V 17/164; F21V 17/10; F21V 23/009; F21V 17/002; F21Y 2115/10; F21Y 2103/33
See application file for complete search history.

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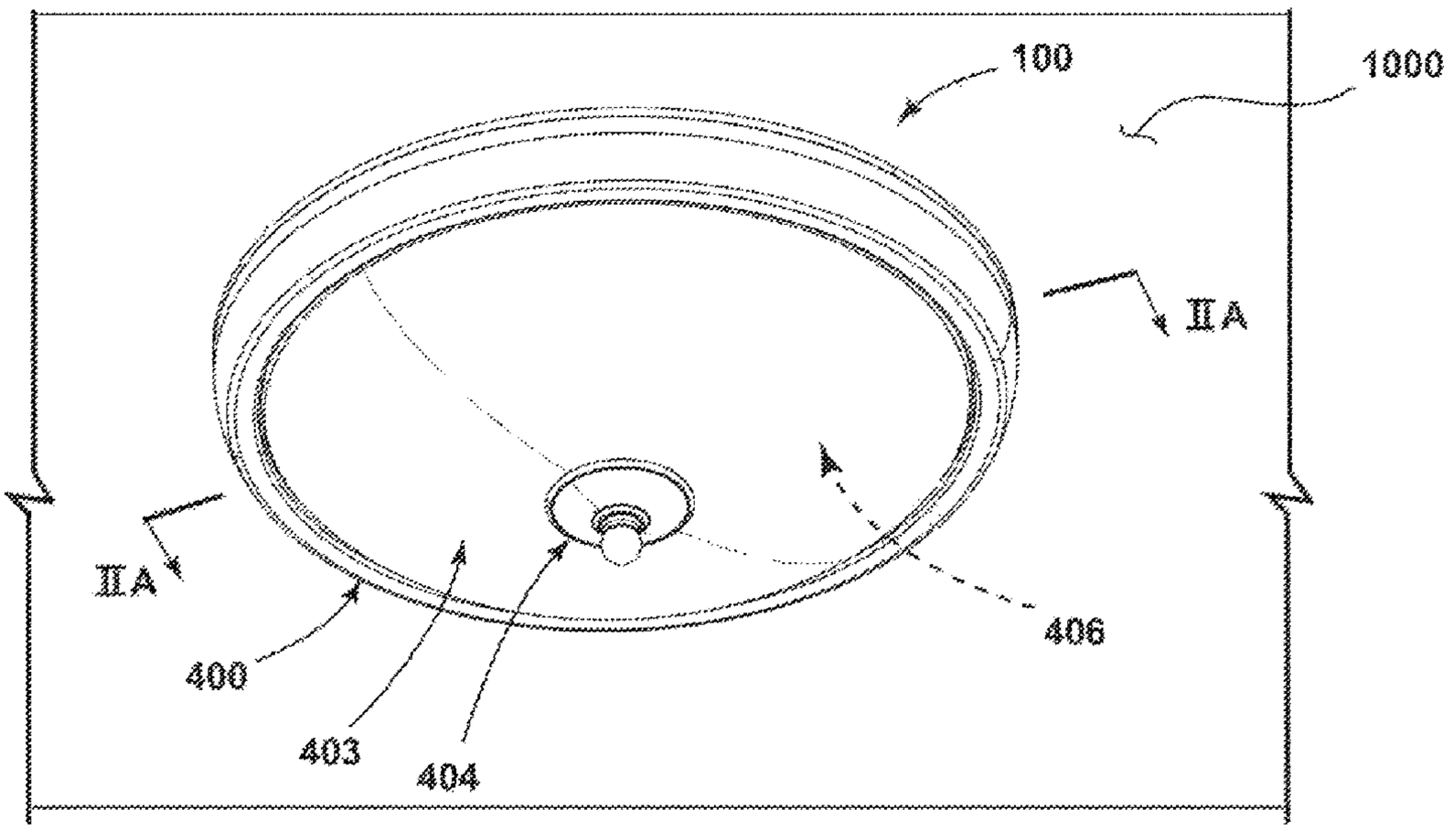
Assistant Examiner — Glenn D. Zimmerman
(74) *Attorney, Agent, or Firm* — Butler Snow LLP; Jon E. Holland

(57) **ABSTRACT**

A modular luminaire assembly comprising includes a mounting ring configured to be selectively coupled with a mounting surface, an inner housing defining a channel configured to receive the mounting ring, wherein the mounting ring is configured to be selectively coupled with the inner housing, a lighting assembly, one or more diffusers configured to direct light from the lighting assembly; and a retaining ring including a ring body defining an opening a plurality of flanges configured to snap engage with the inner housing, wherein the ring body is configured to at least partially support the one or more diffusers and the lighting assembly.

20 Claims, 31 Drawing Sheets



(51) **Int. Cl.**

F21V 5/00	(2018.01)
F21V 29/70	(2015.01)
F21Y 115/10	(2016.01)

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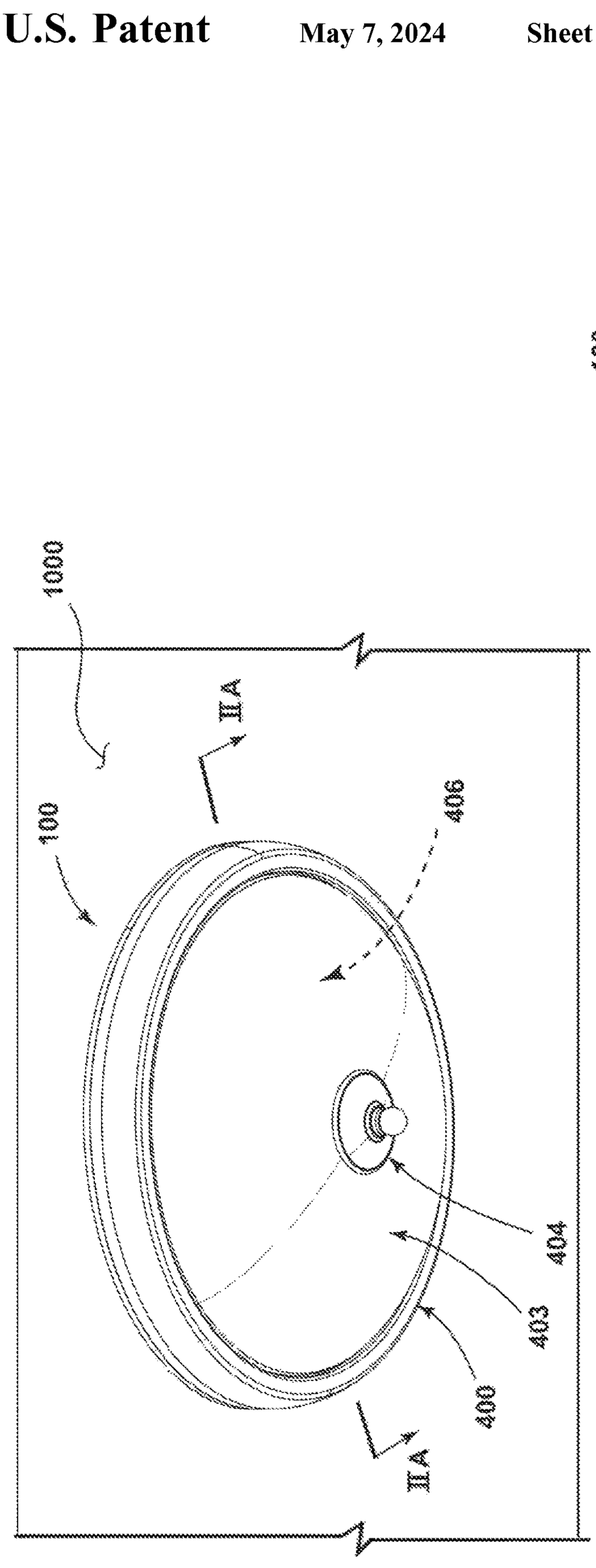

FIG. 1

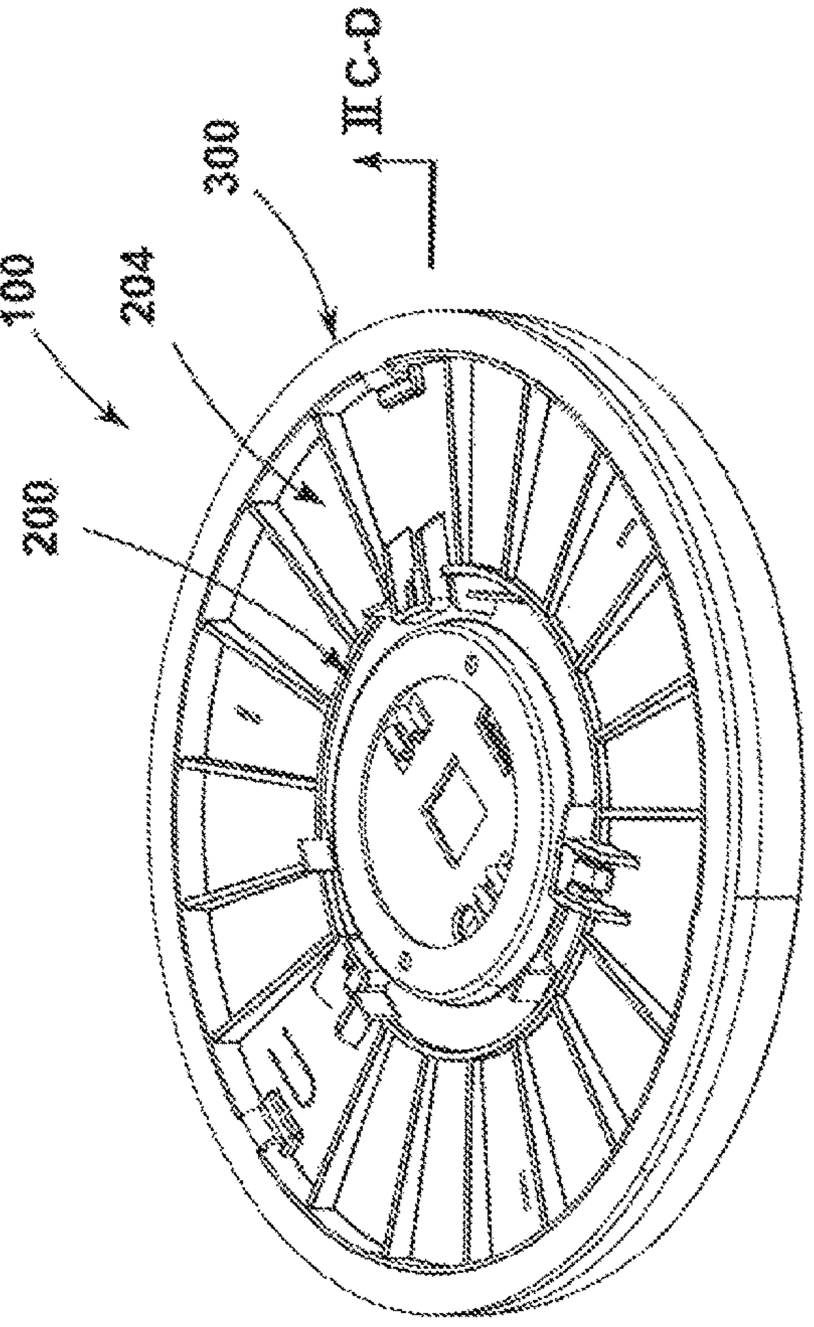

FIG. 2

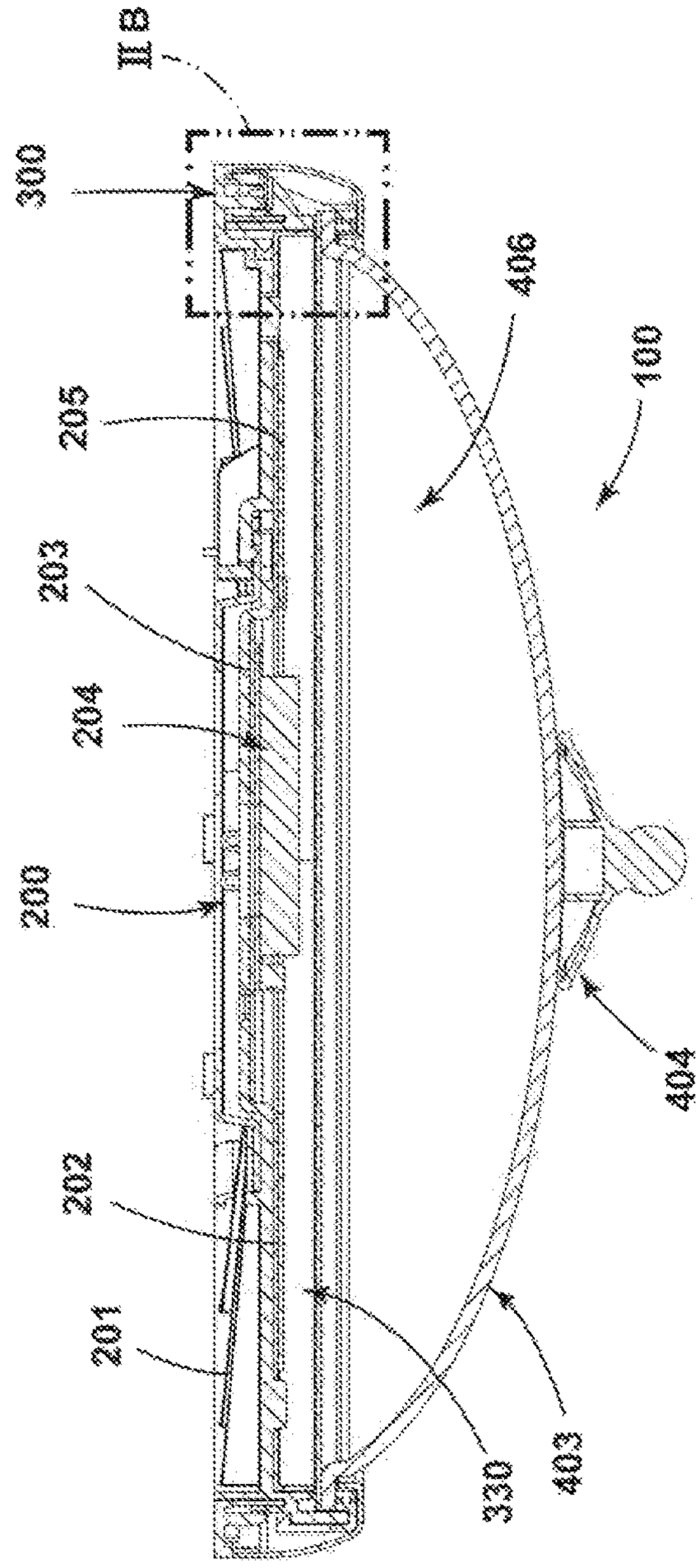
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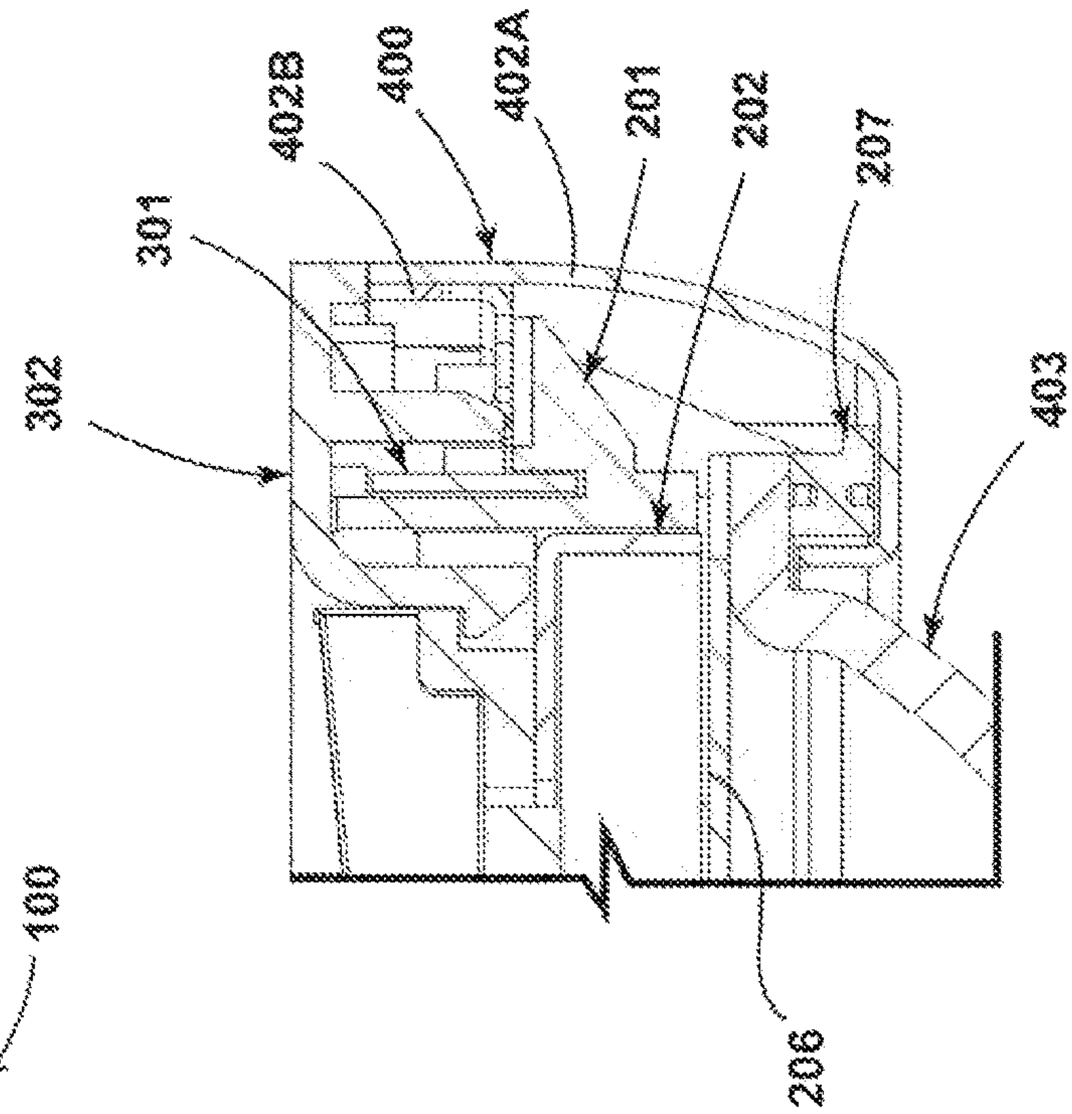
FIG. 2A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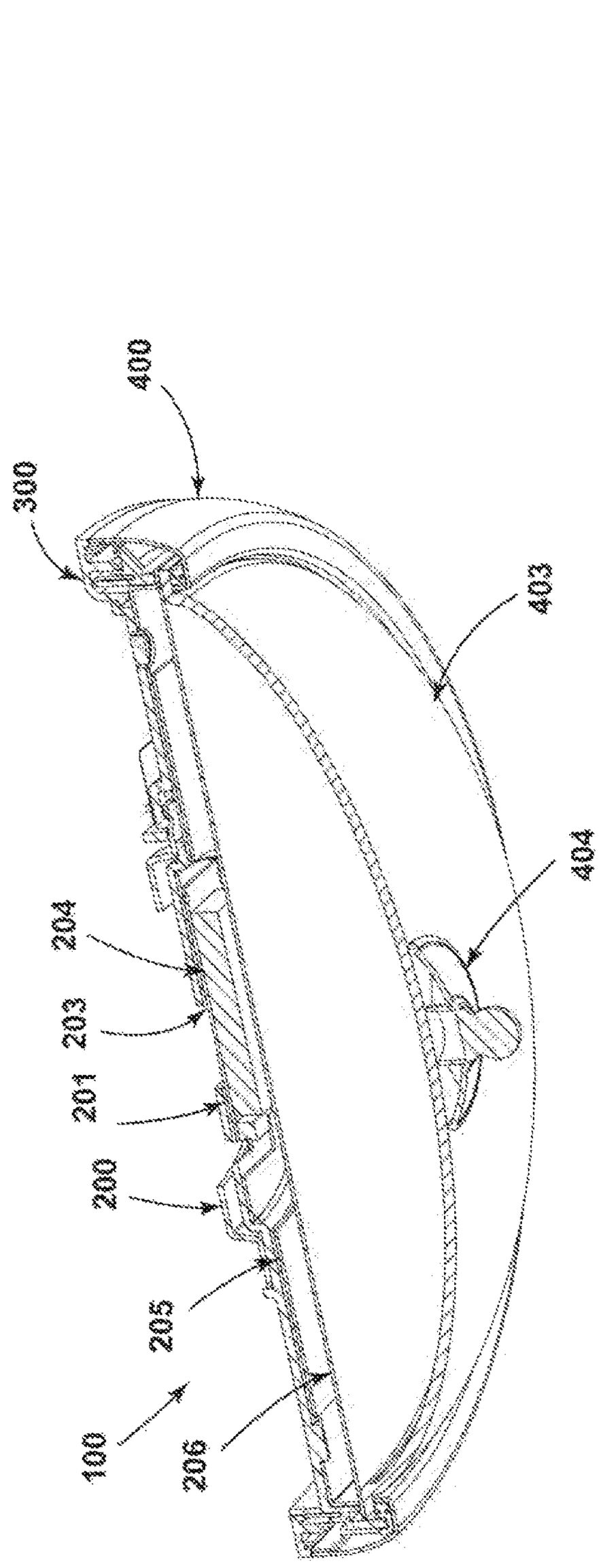
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FIG. 2C

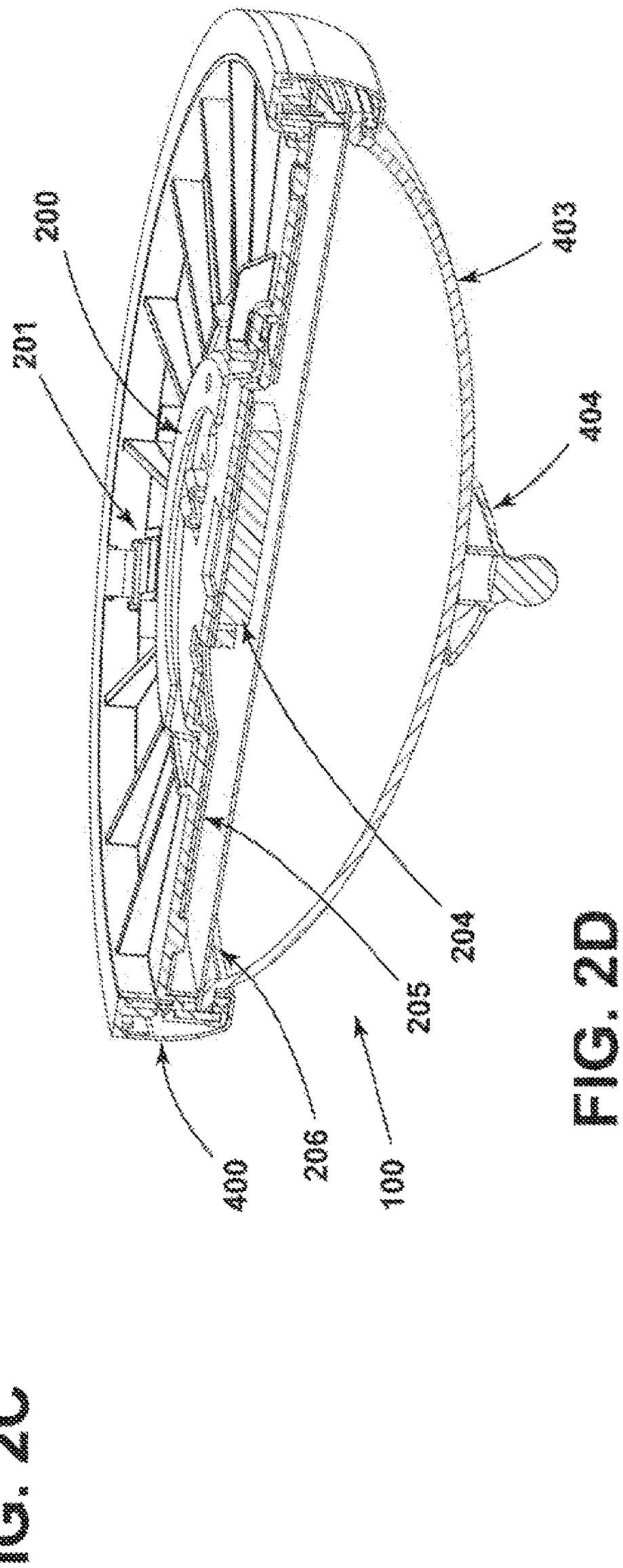
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FIG. 2D

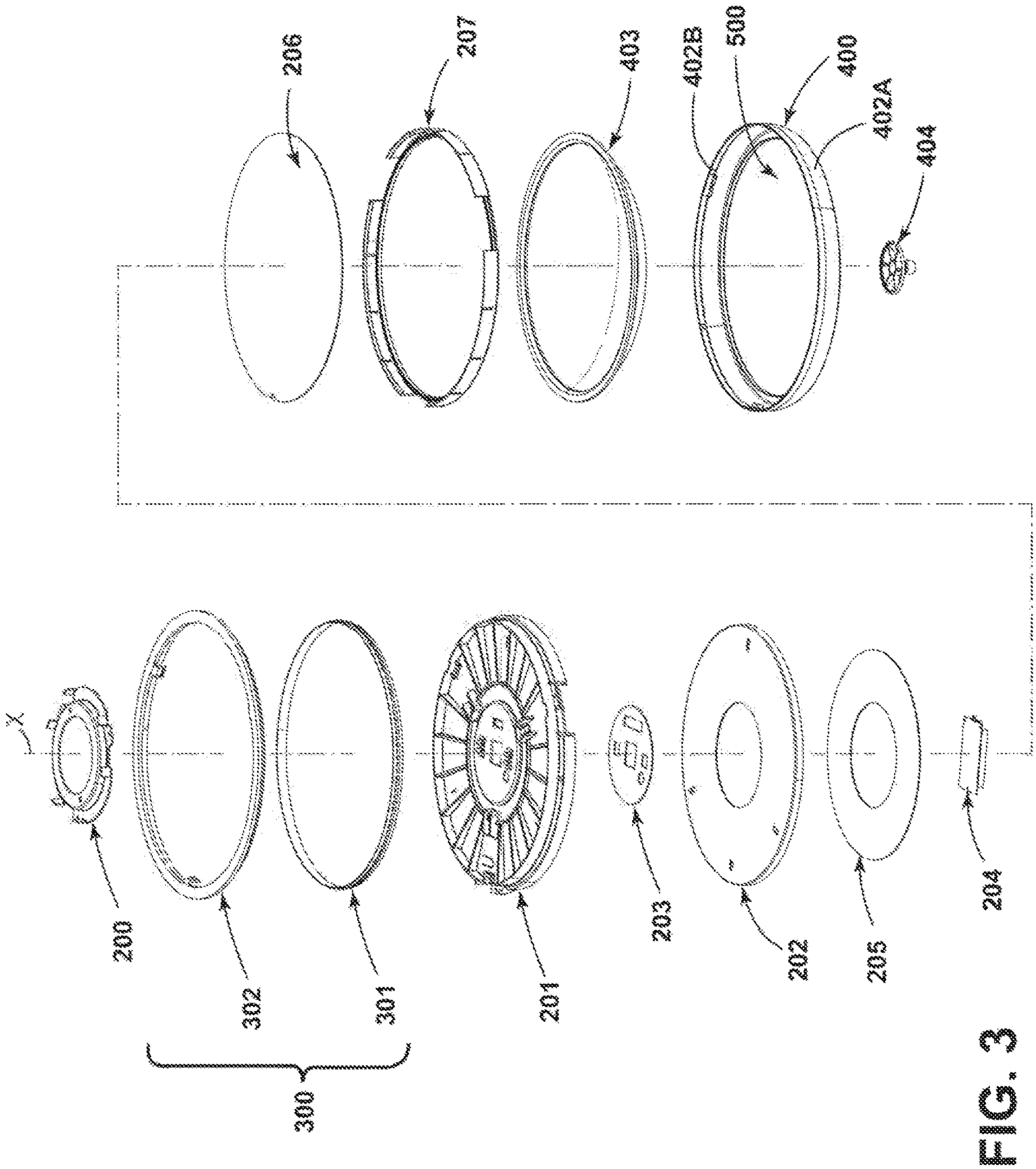
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FIG. 3

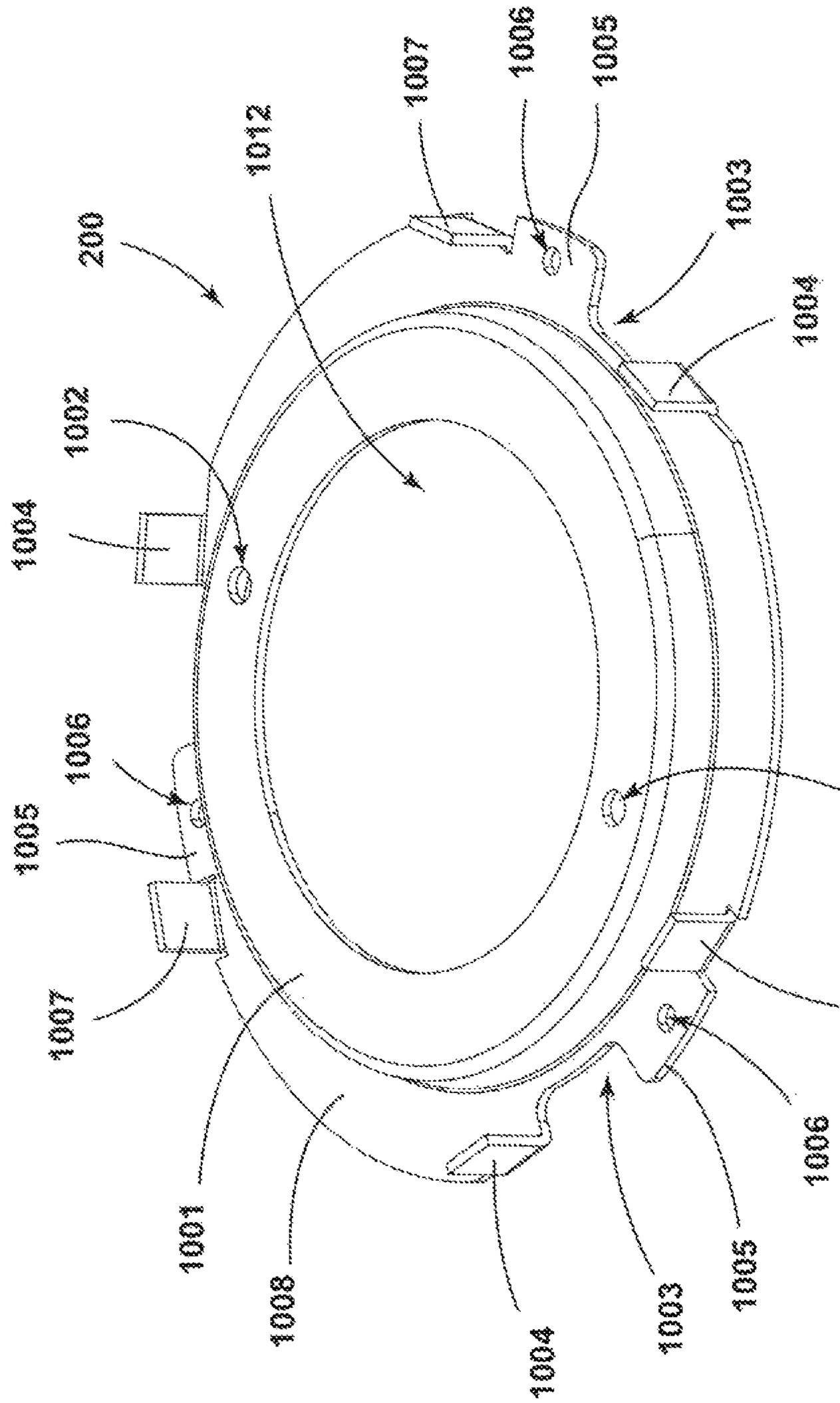
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FIG. 4

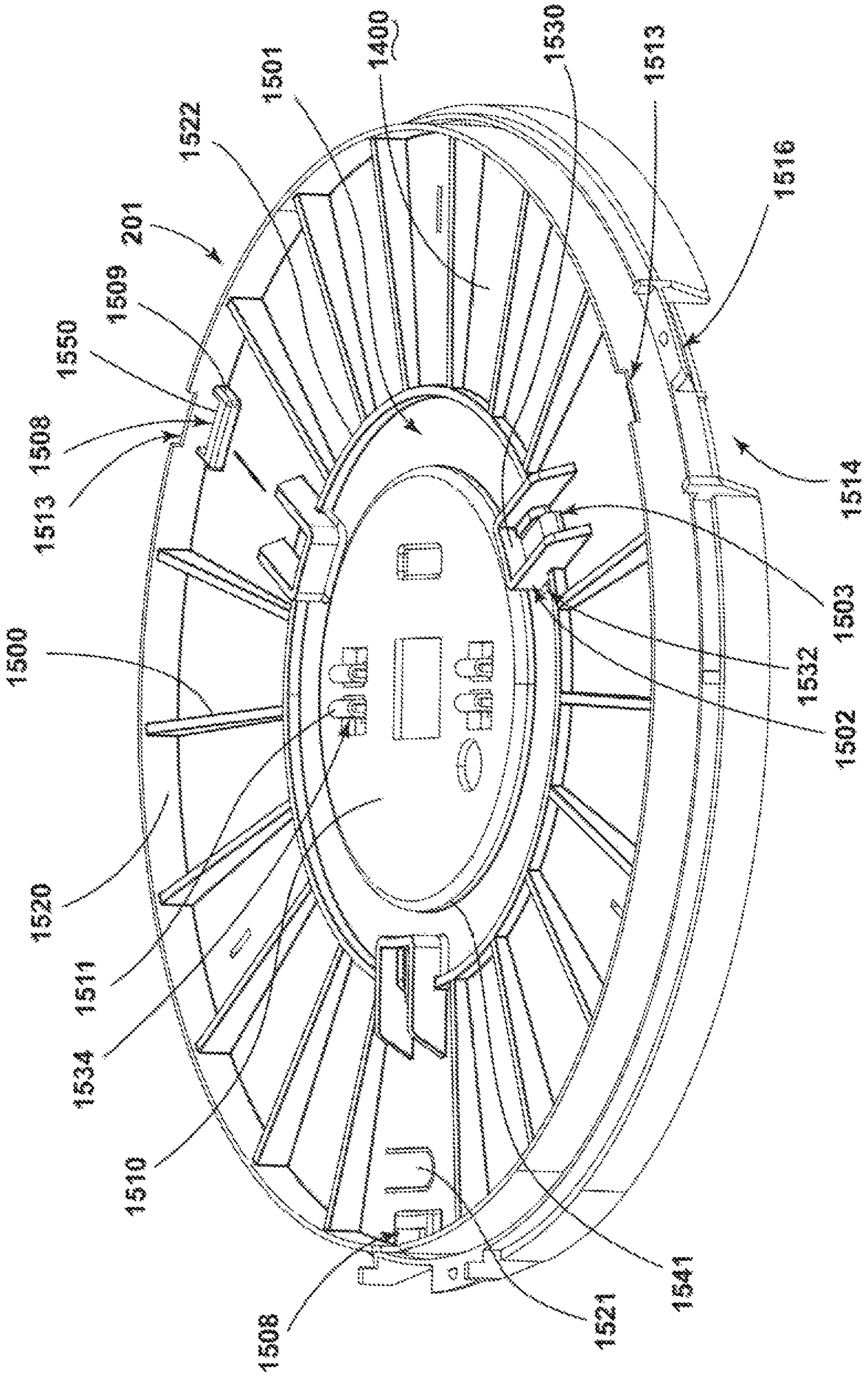
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FIG. 5

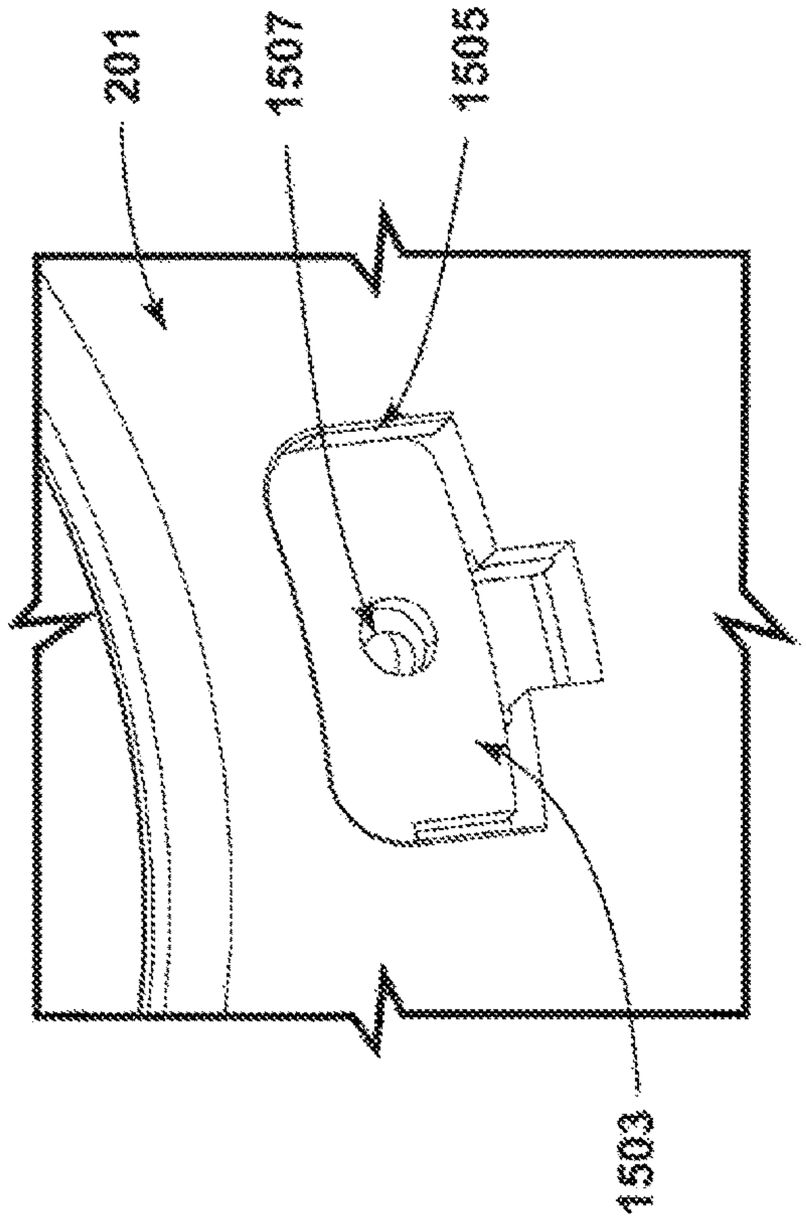
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FIG. 6

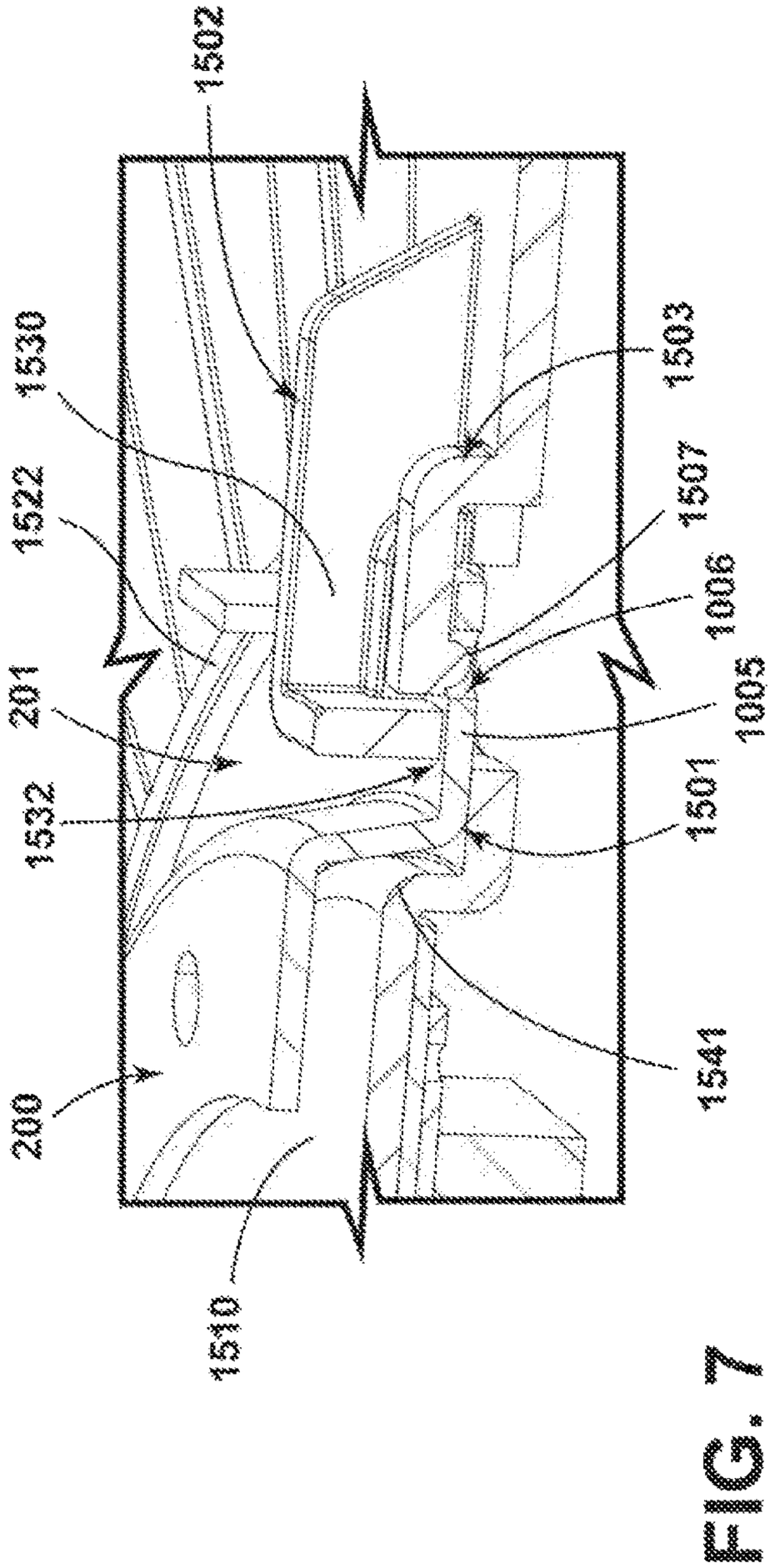
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FIG. 7

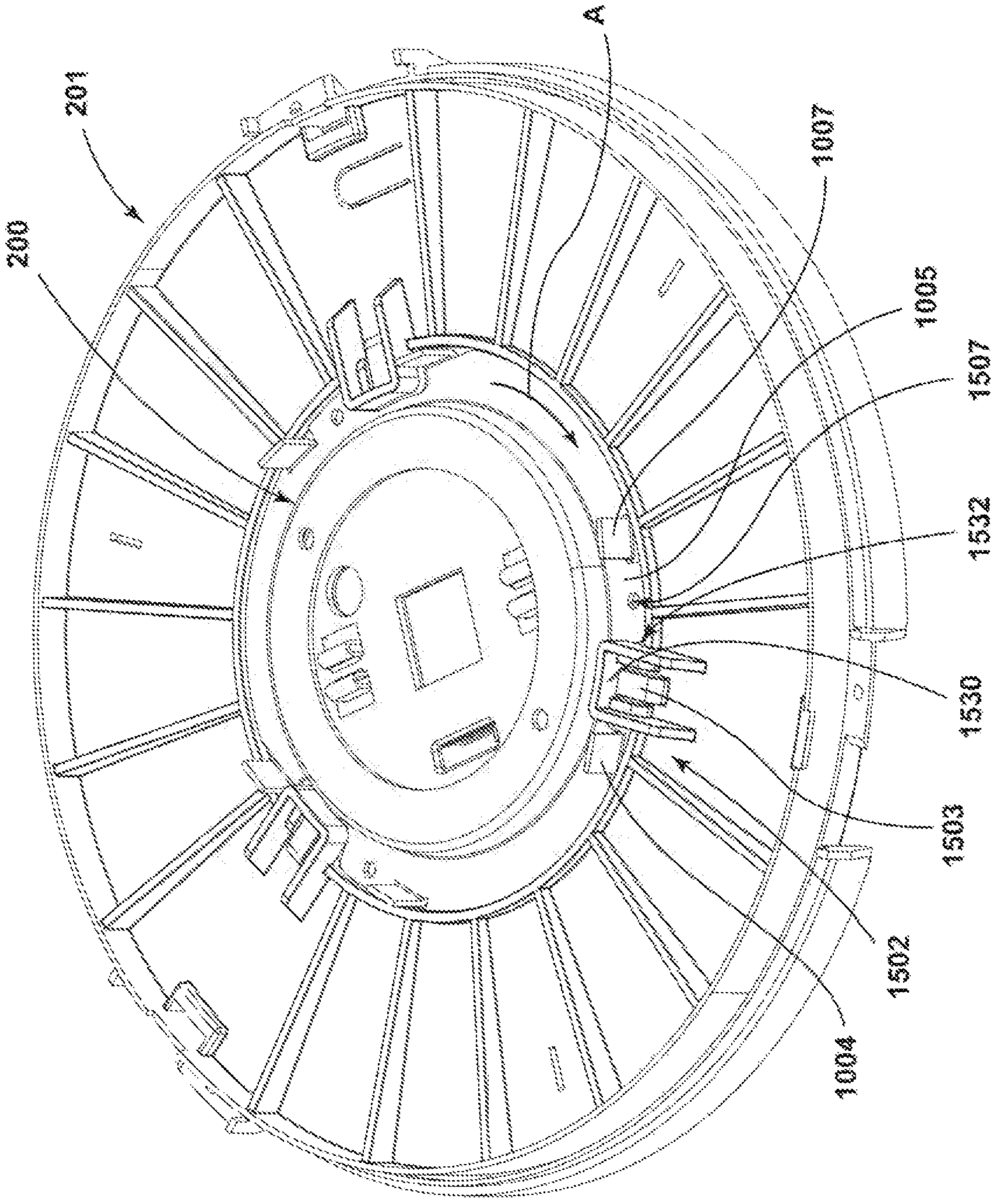
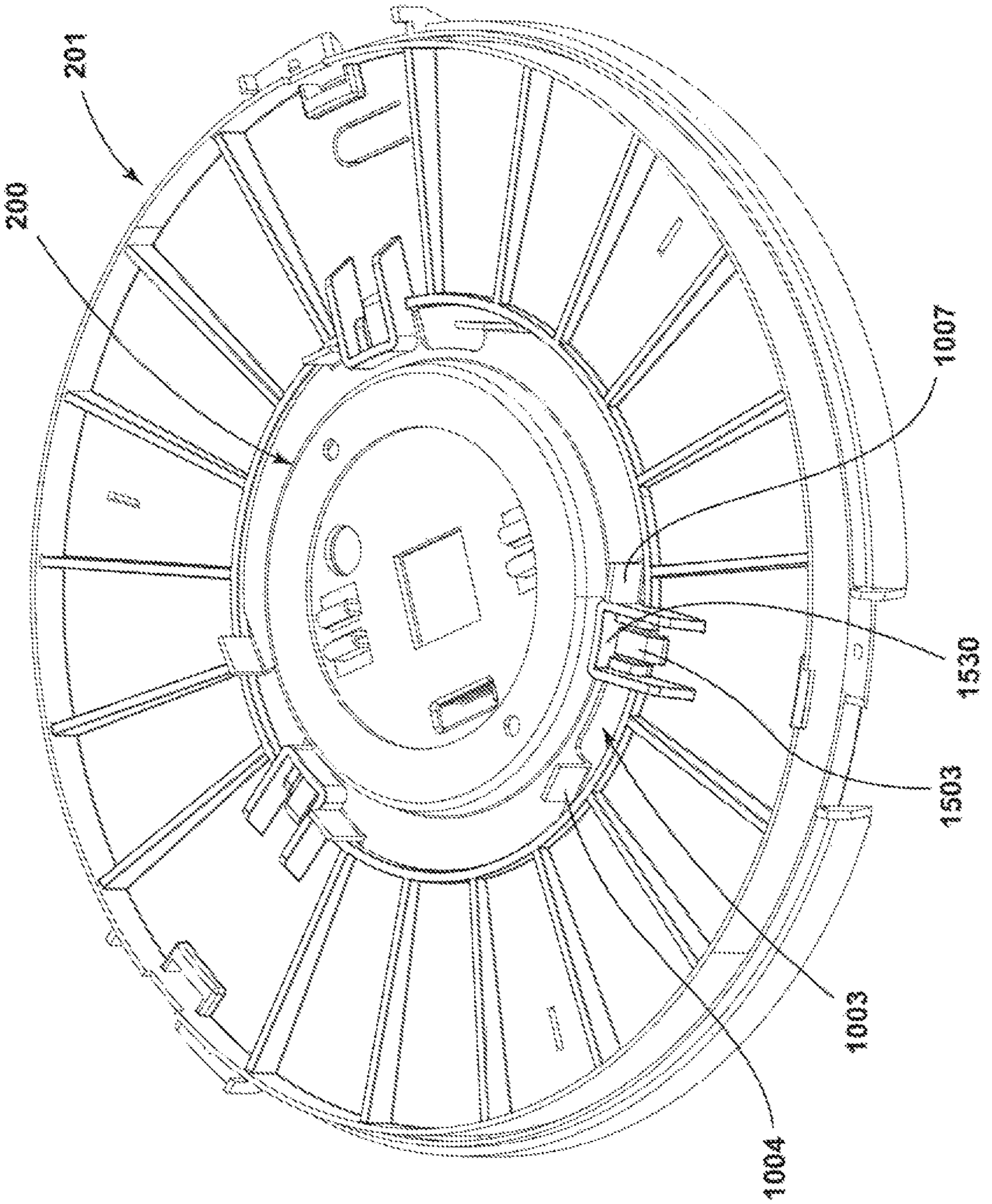


FIG. 8



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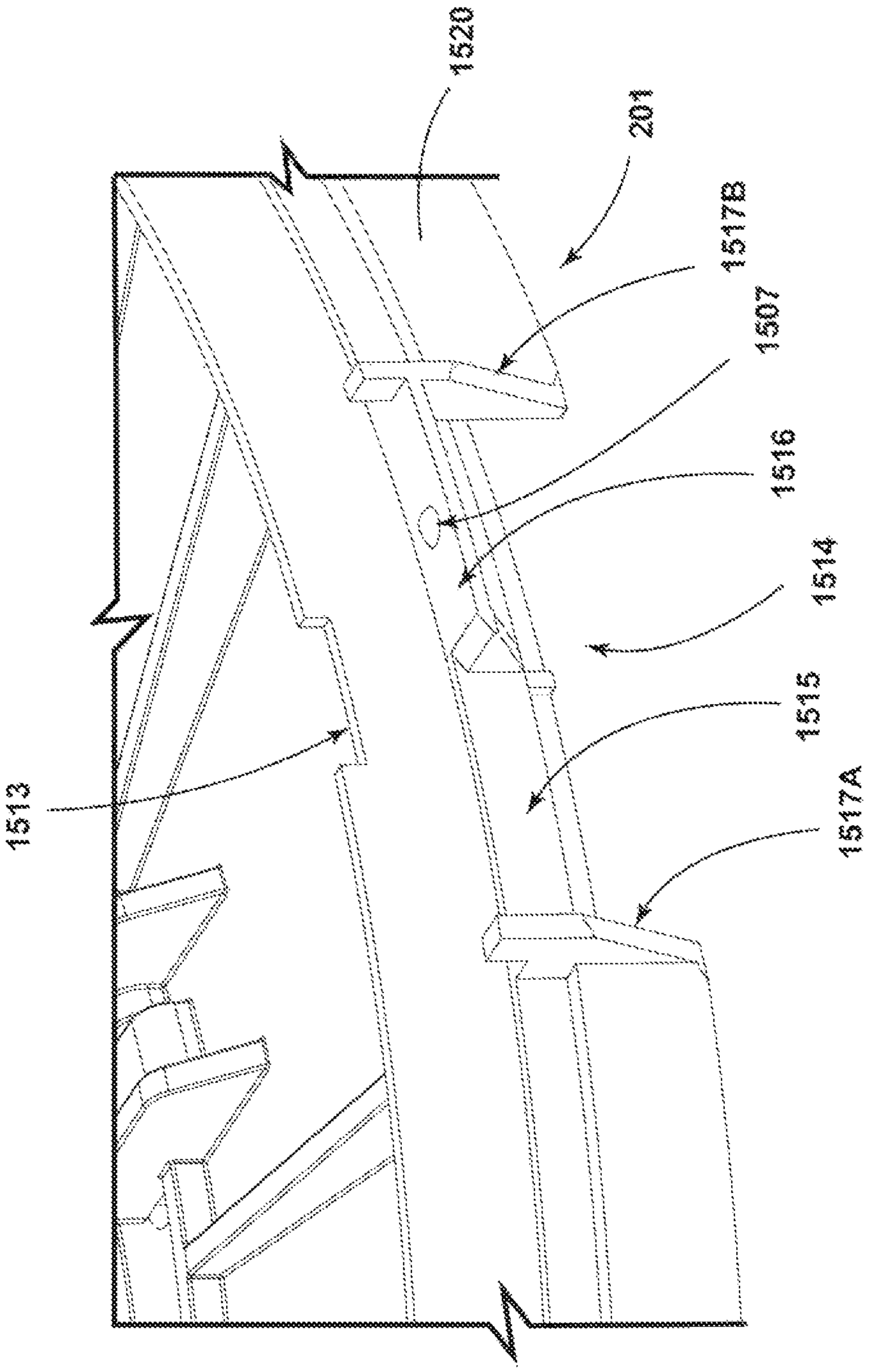

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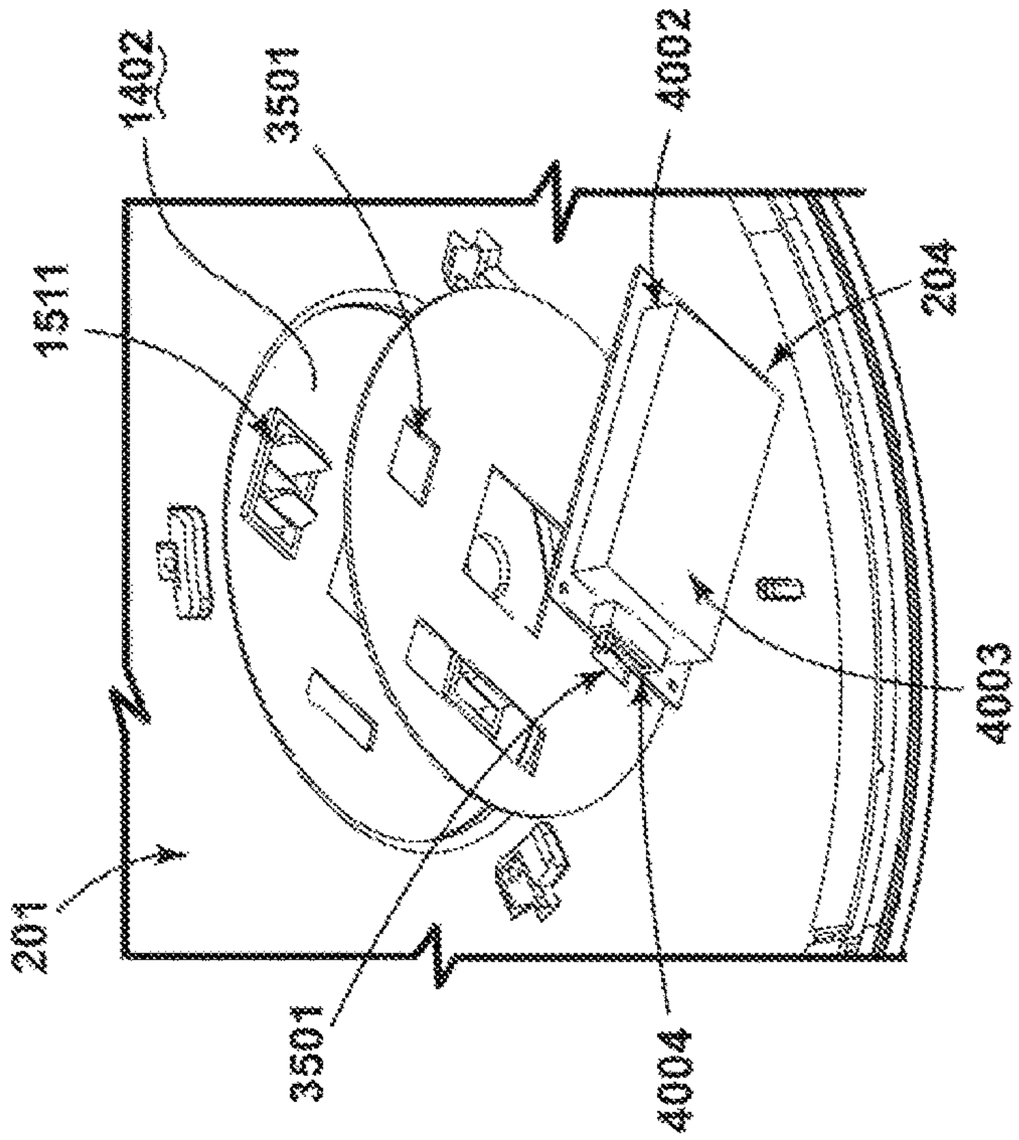

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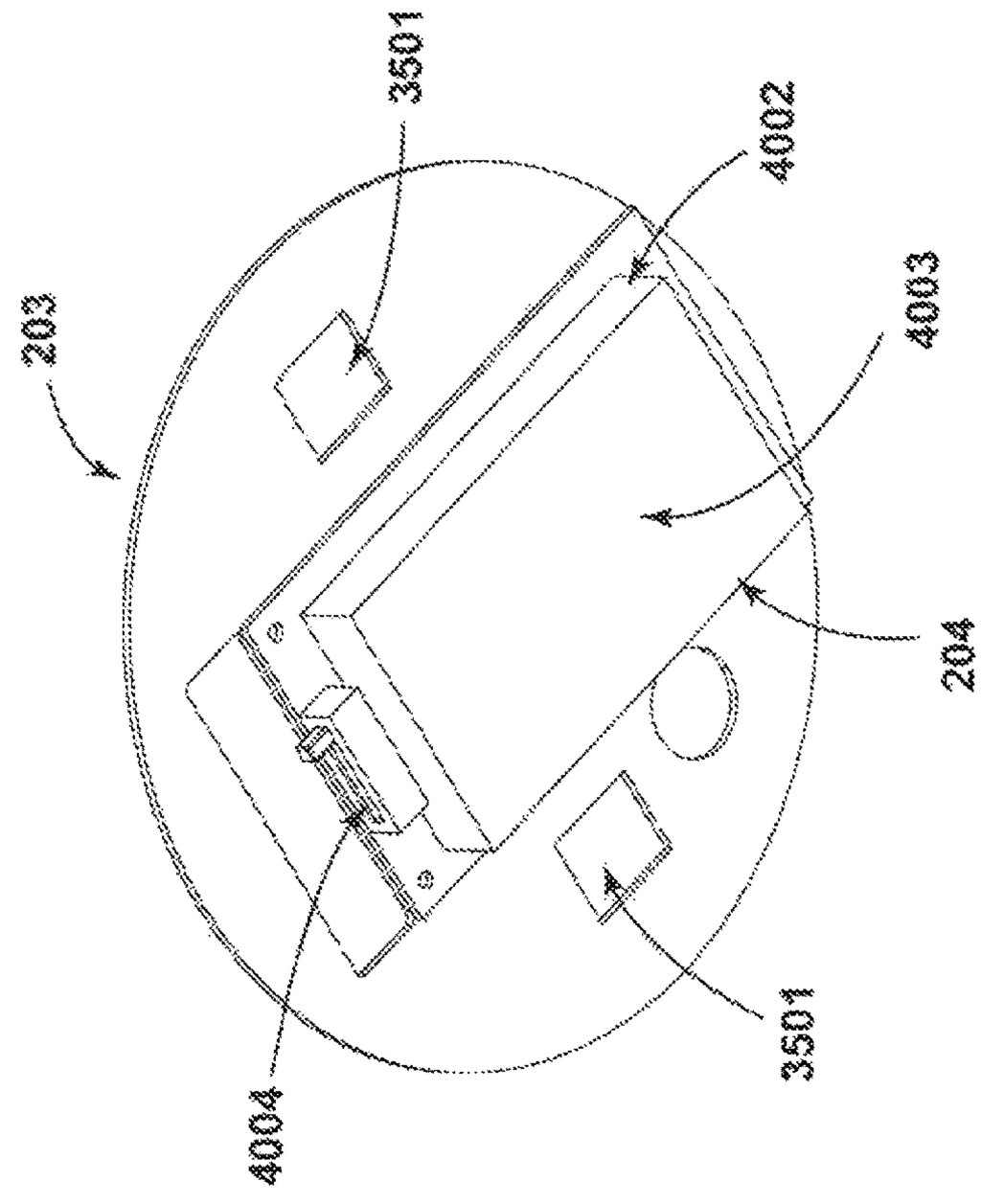
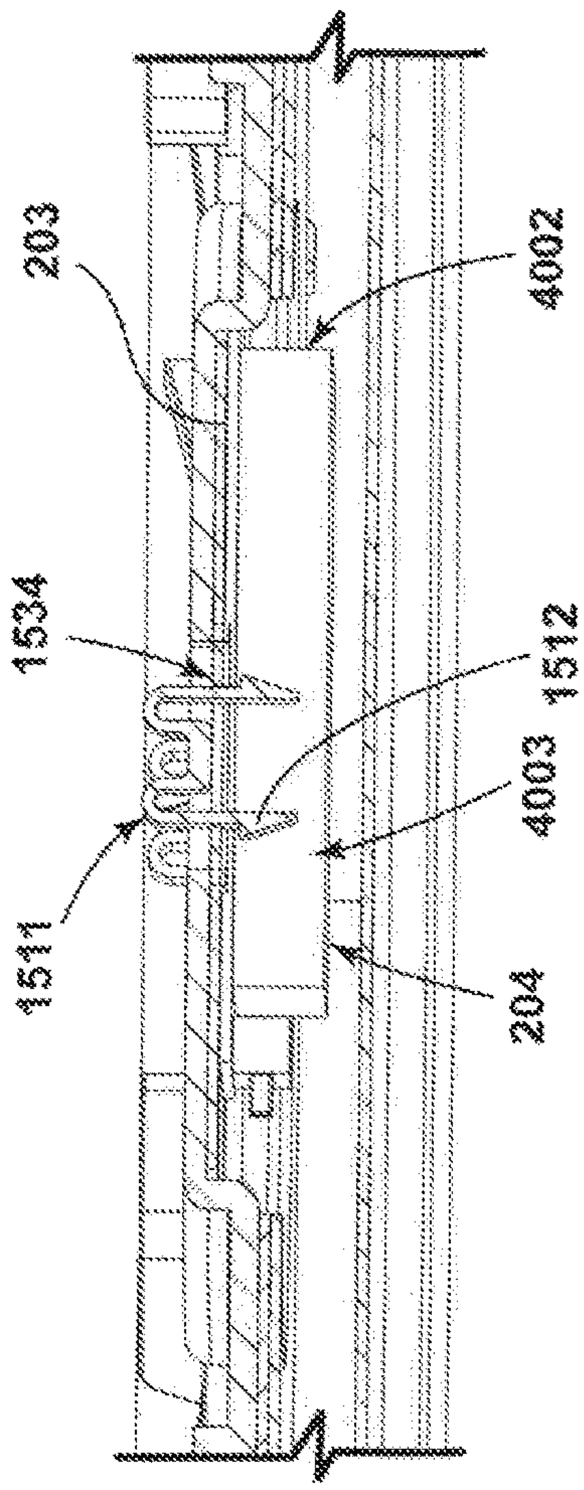


FIG. 11



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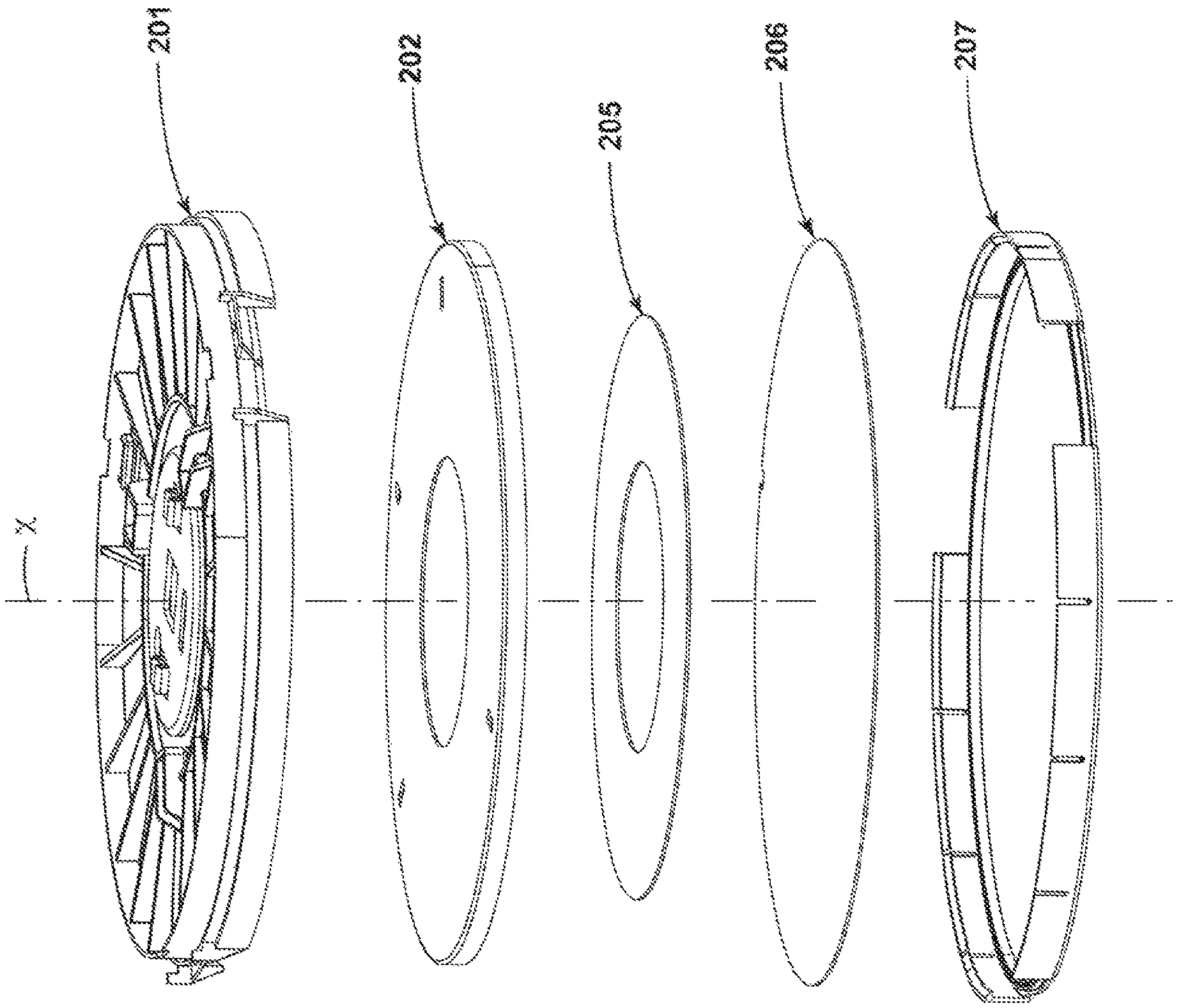

FIG. 14

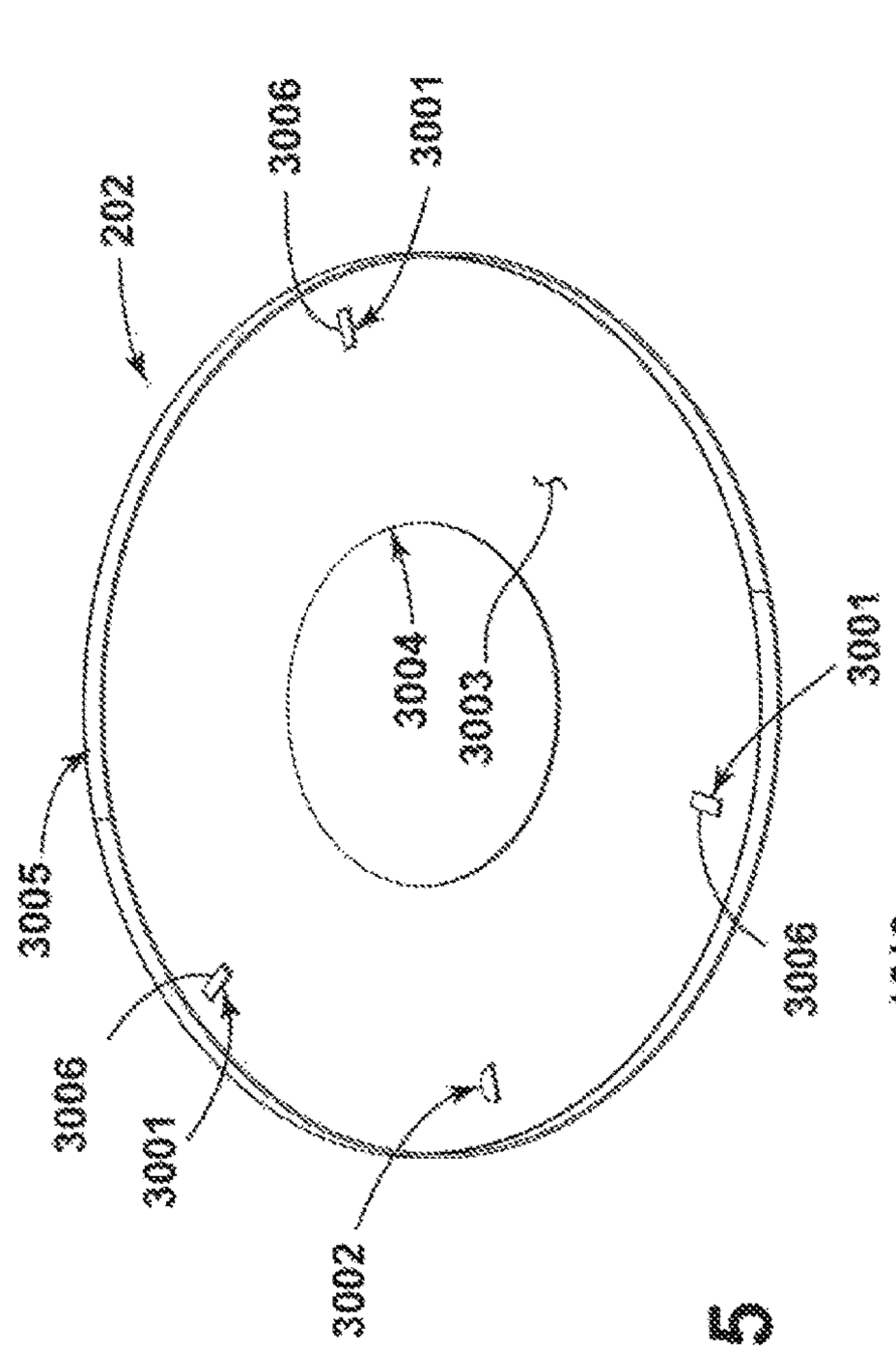
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FIG. 15

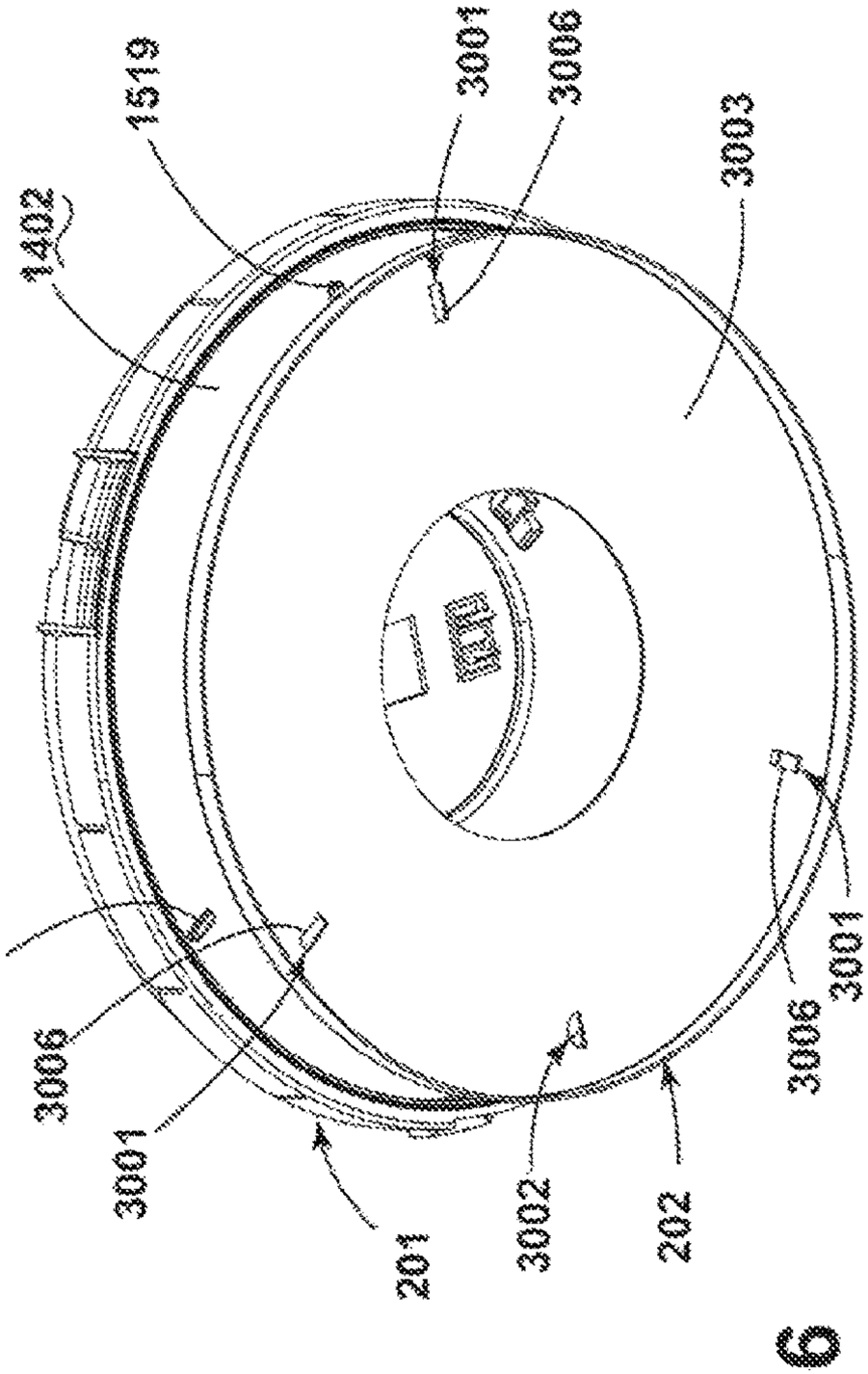
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FIG. 16

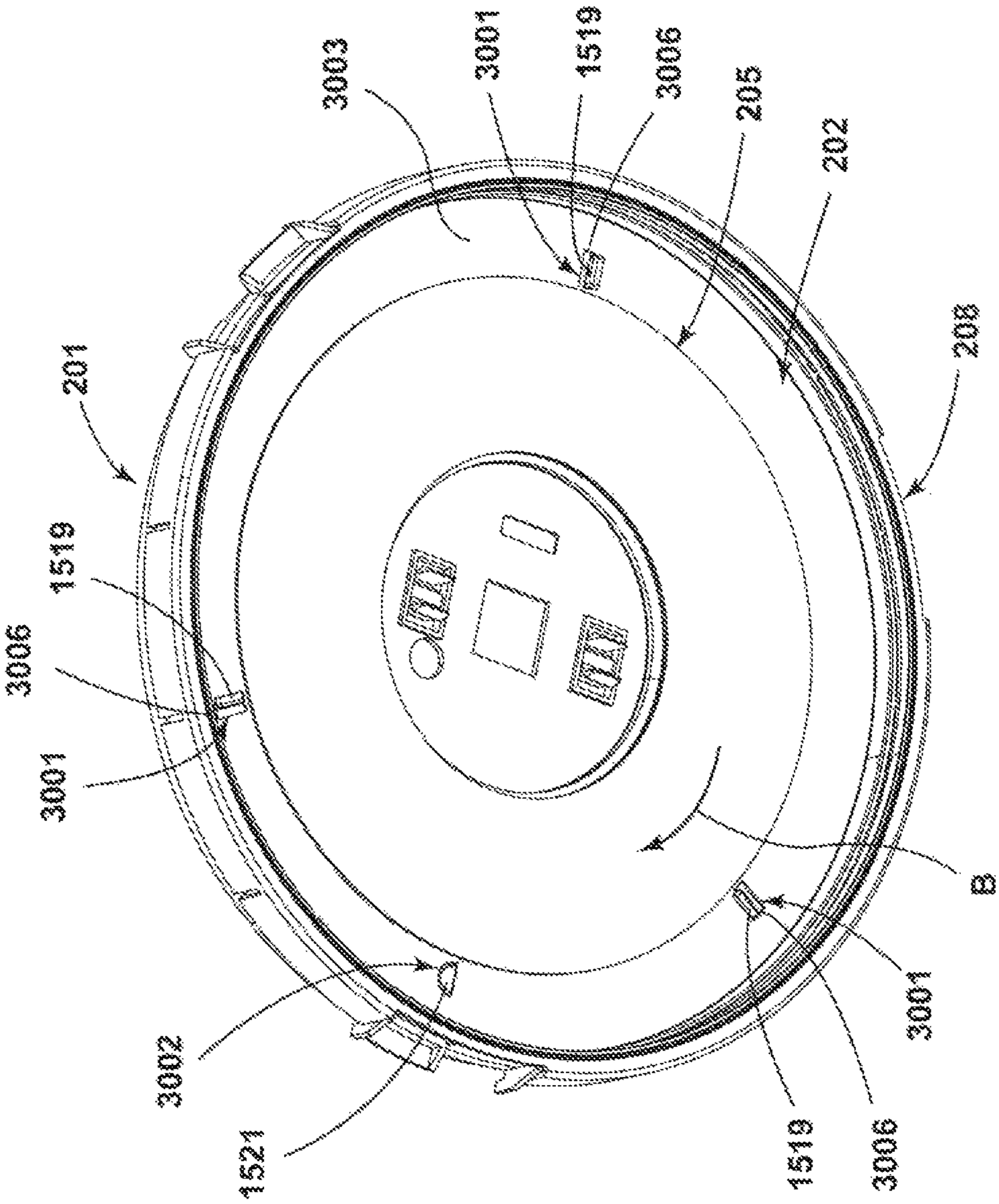
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FIG. 17

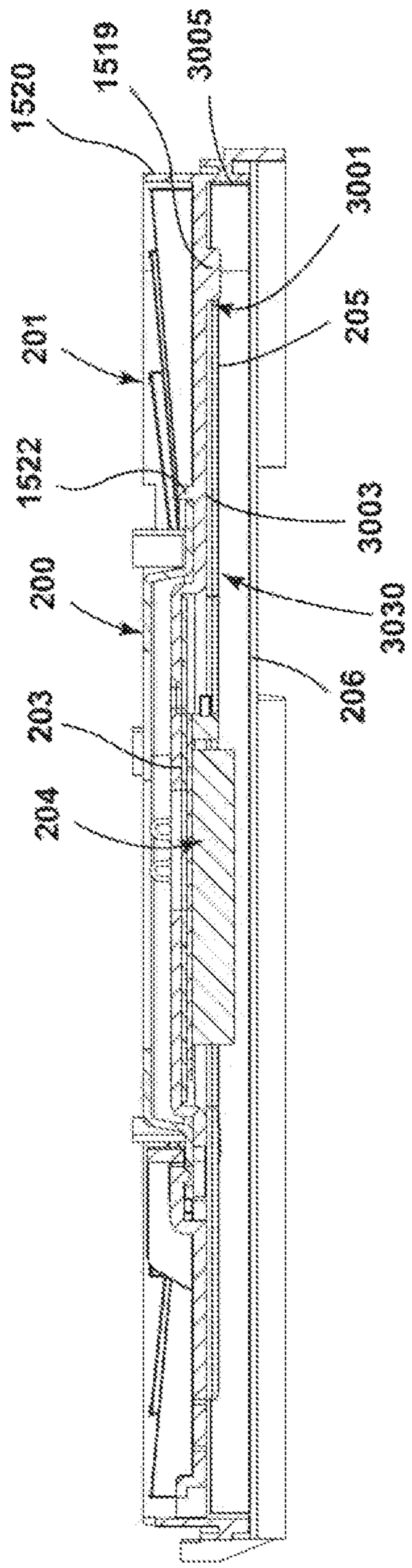
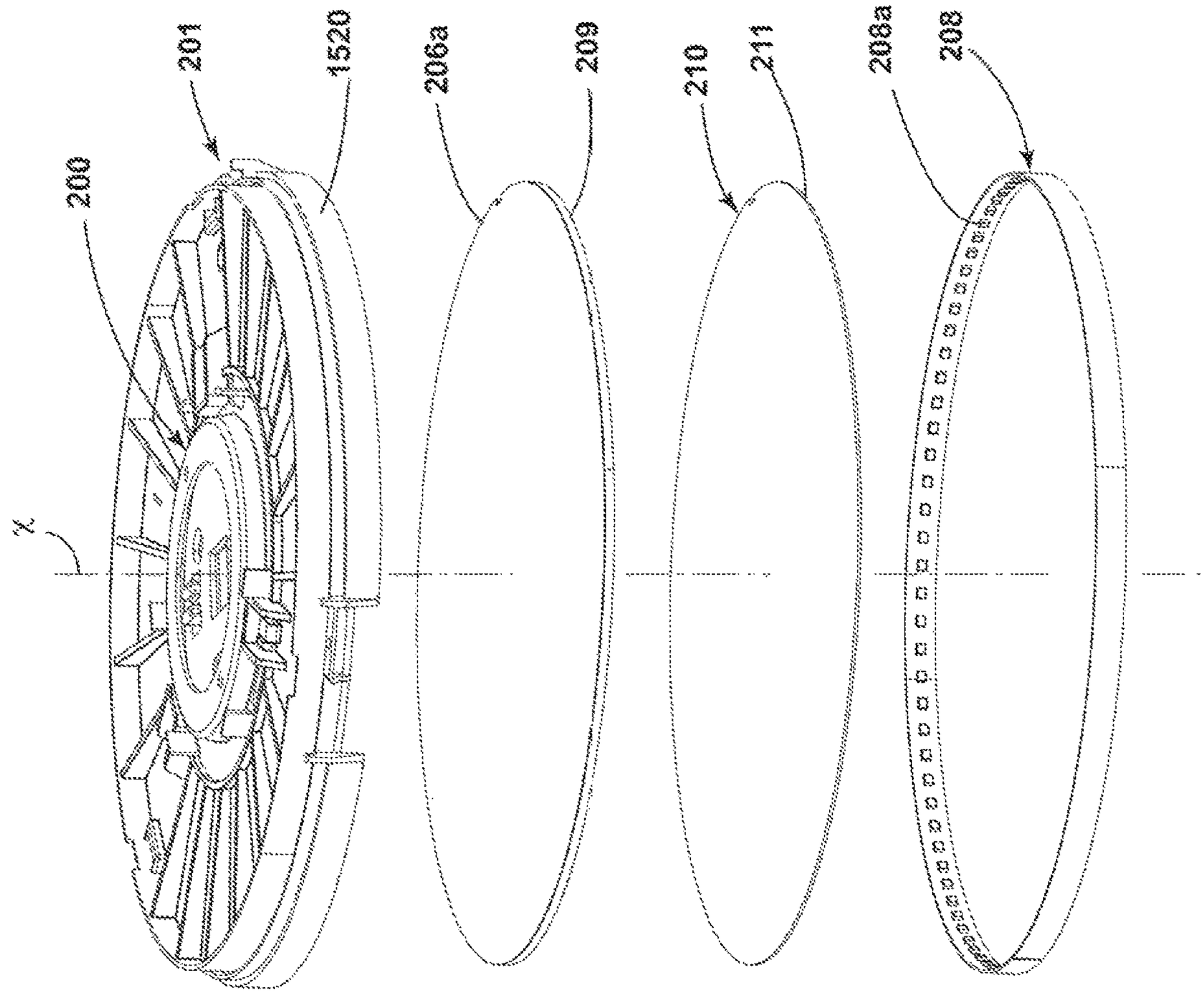


FIG. 18



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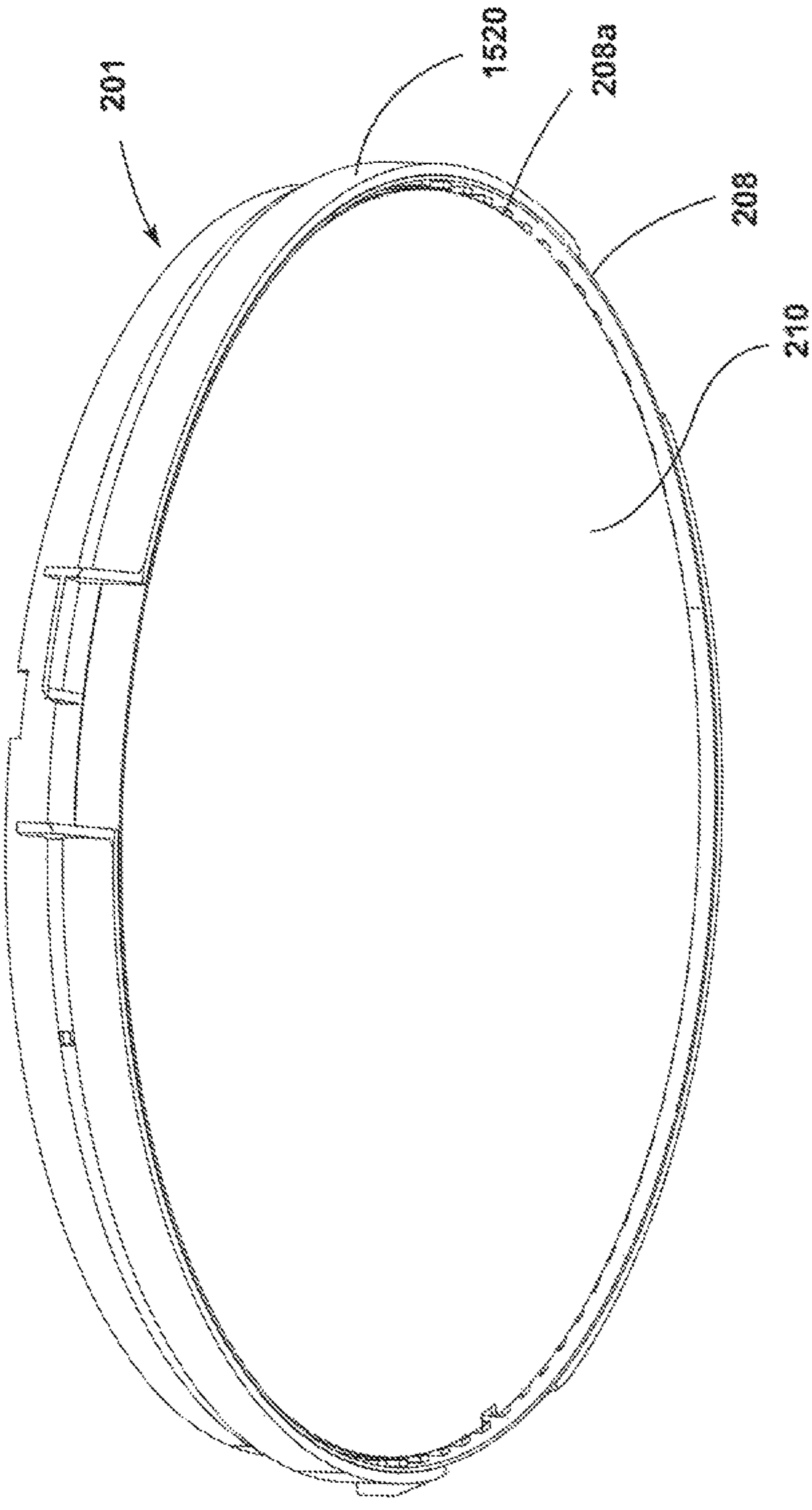

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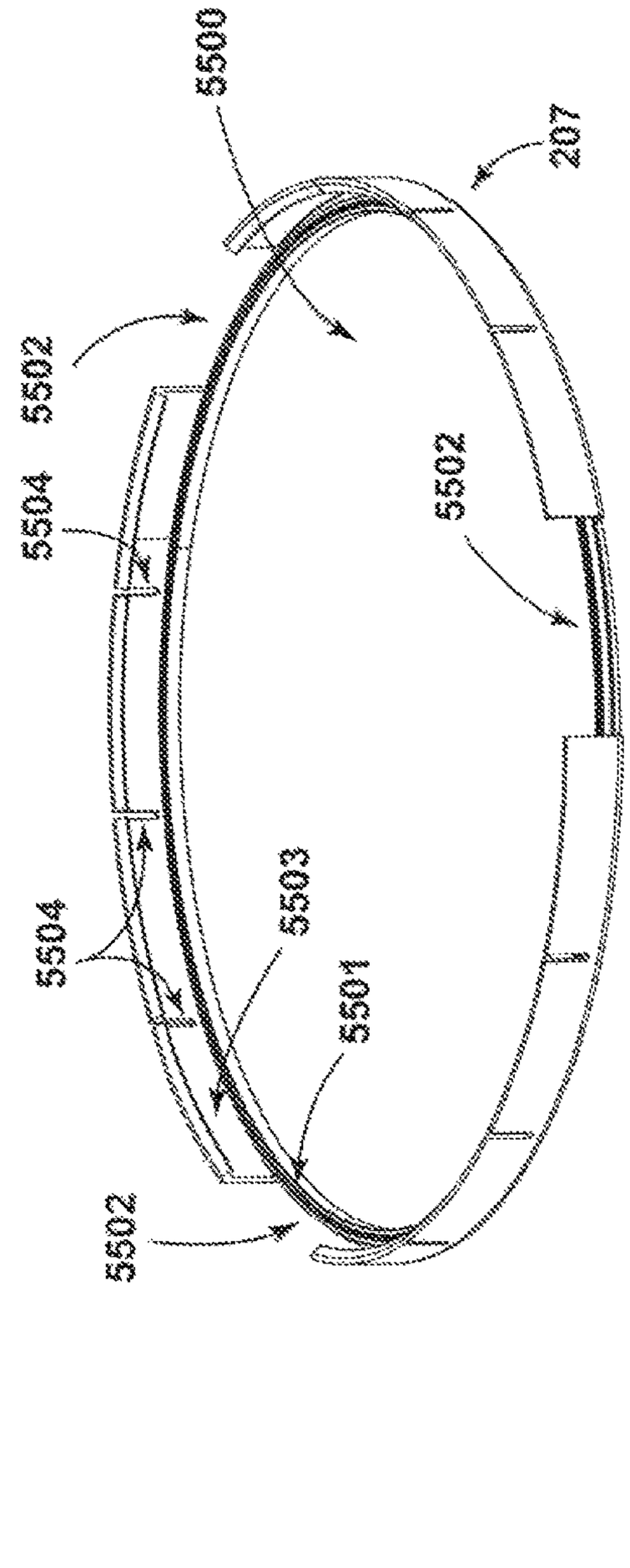
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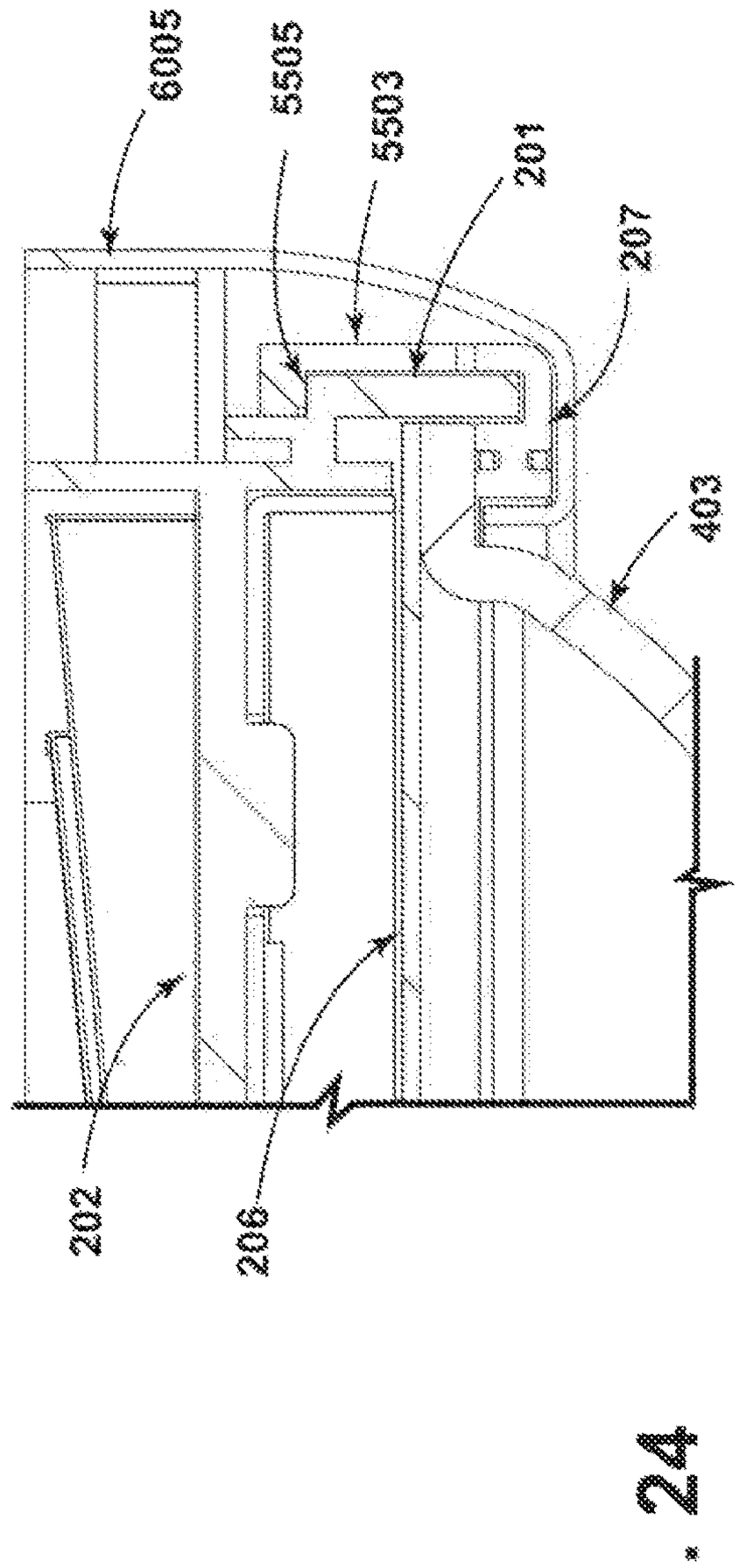
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FIG. 24

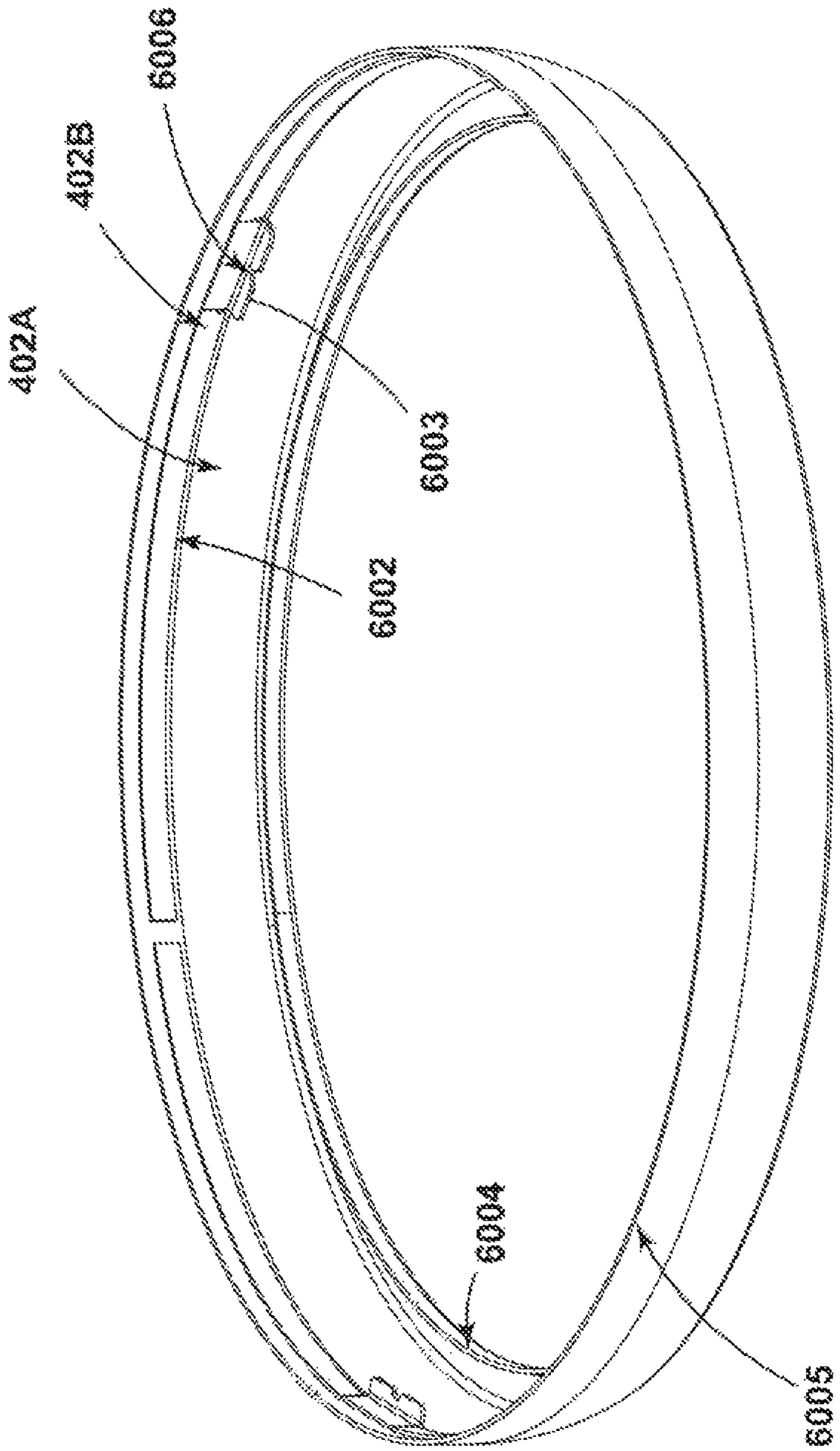
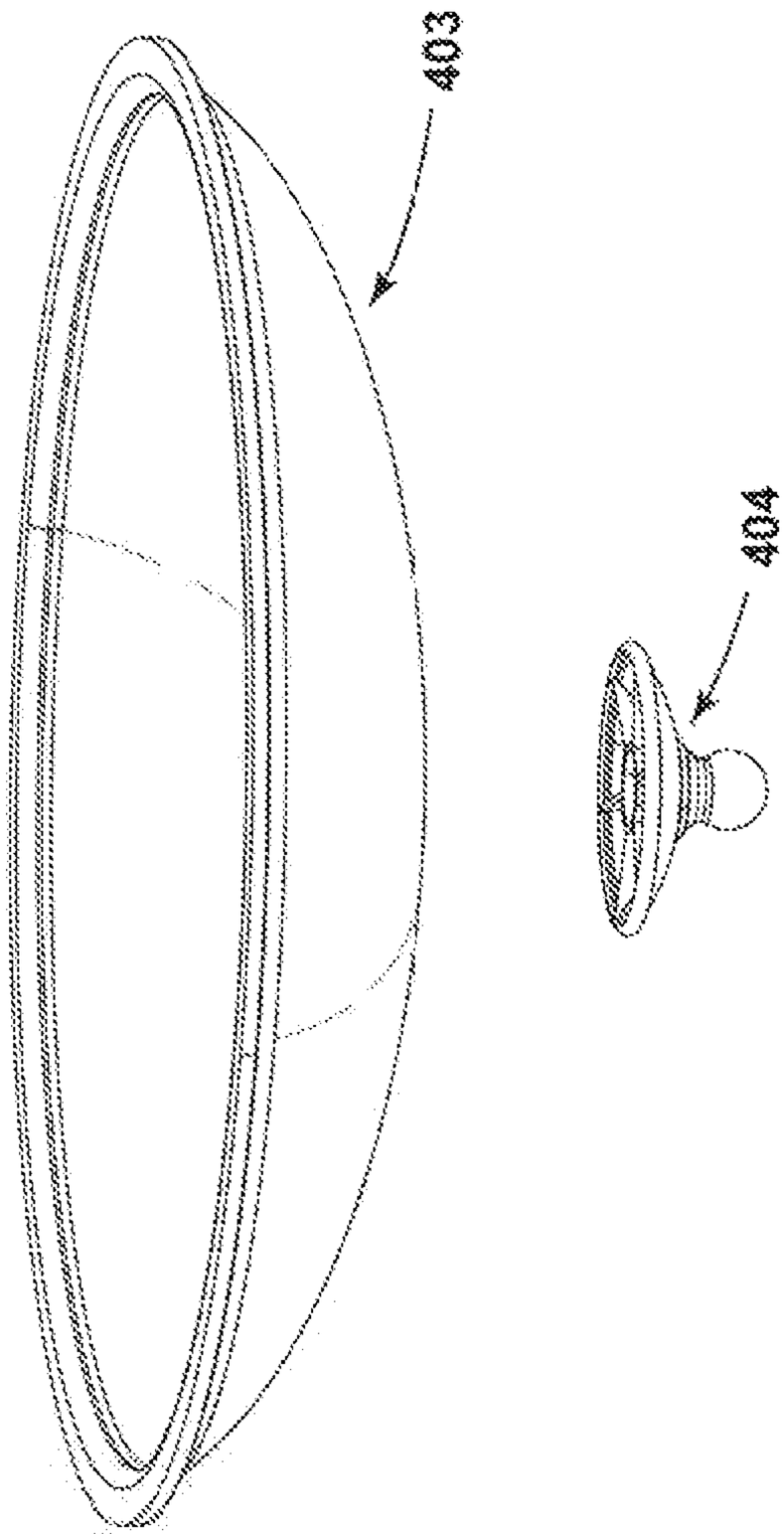


FIG. 22



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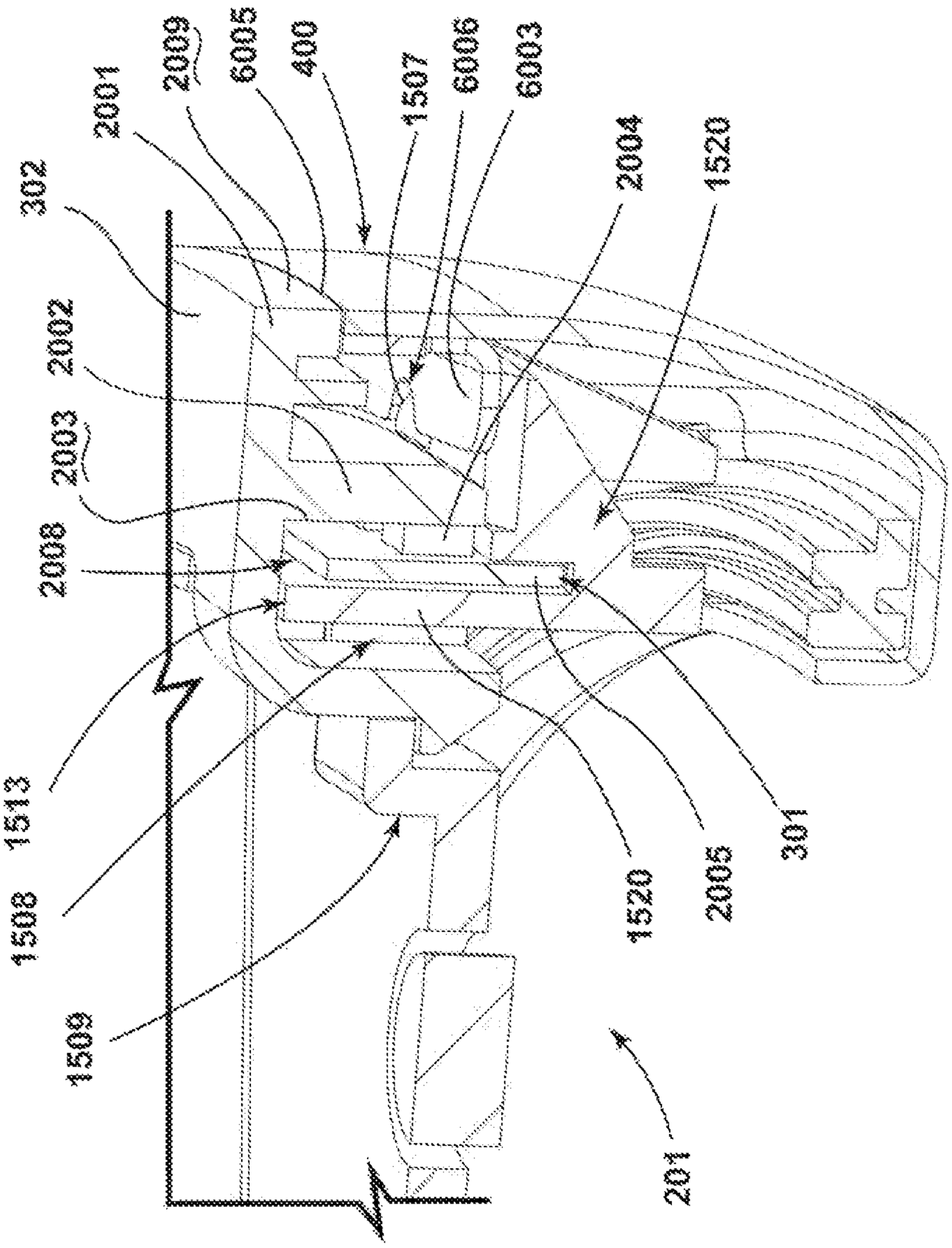
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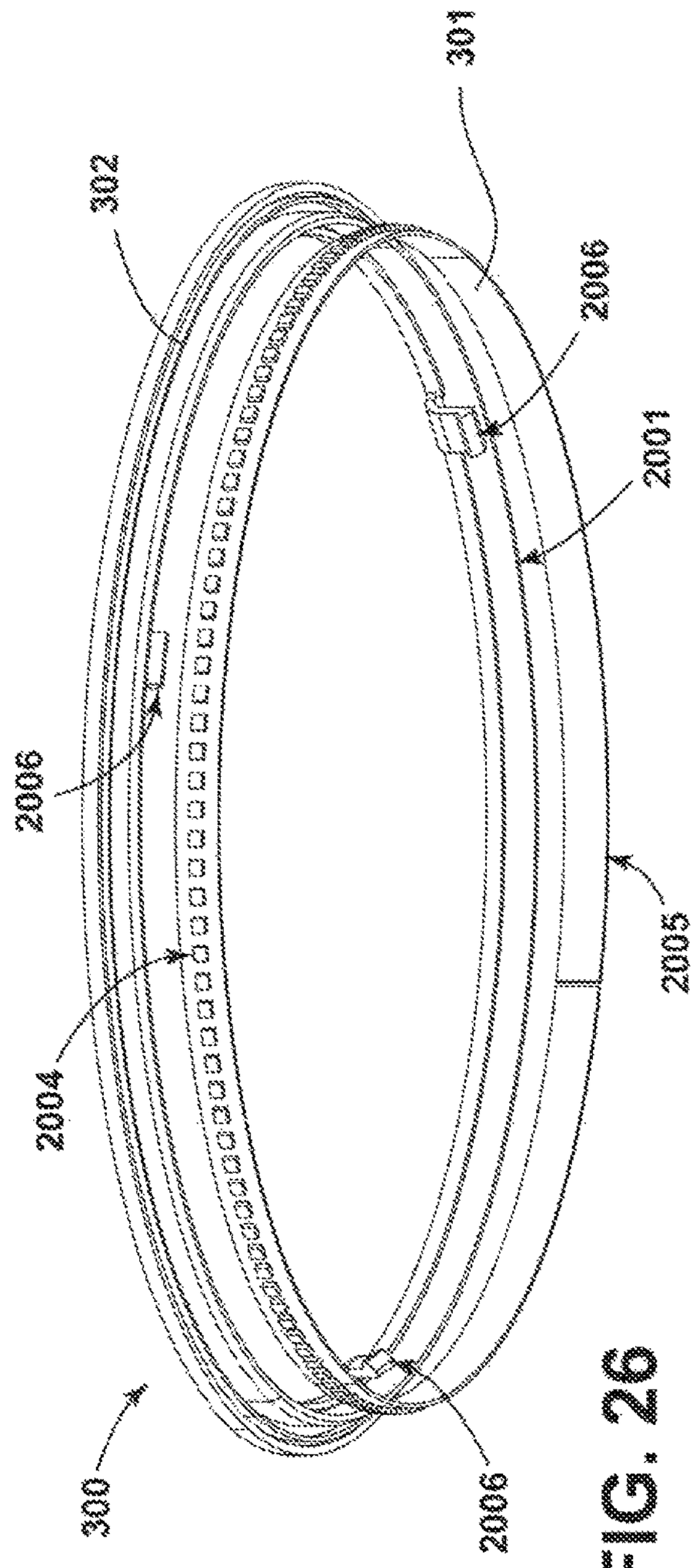
FIG. 25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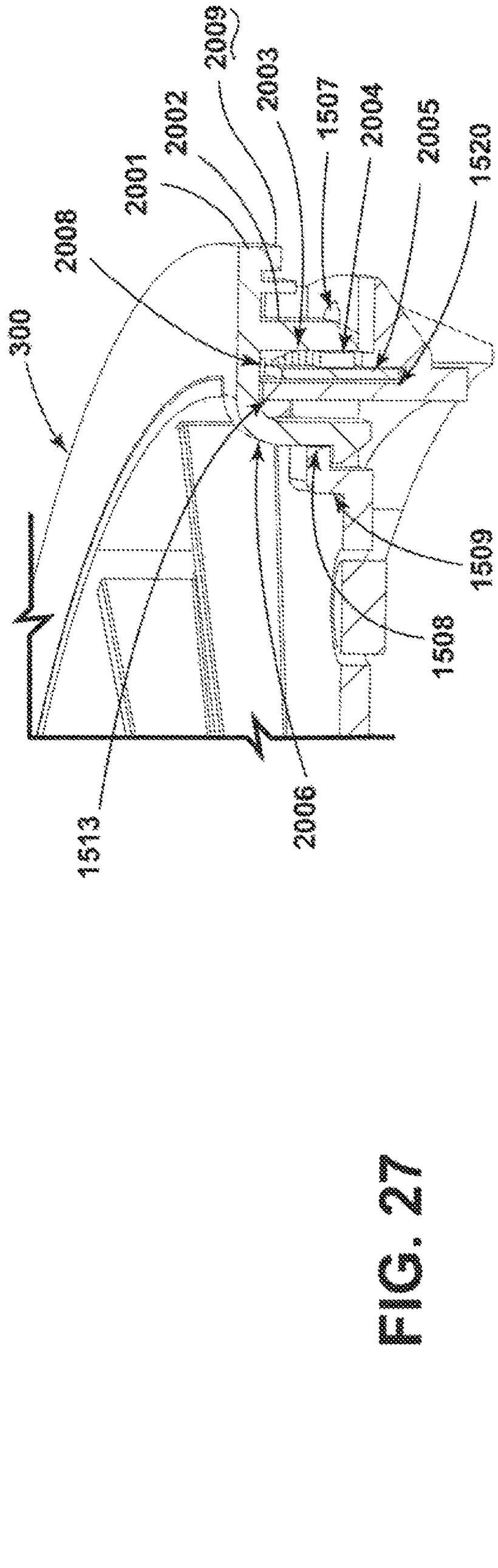
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FIG. 27

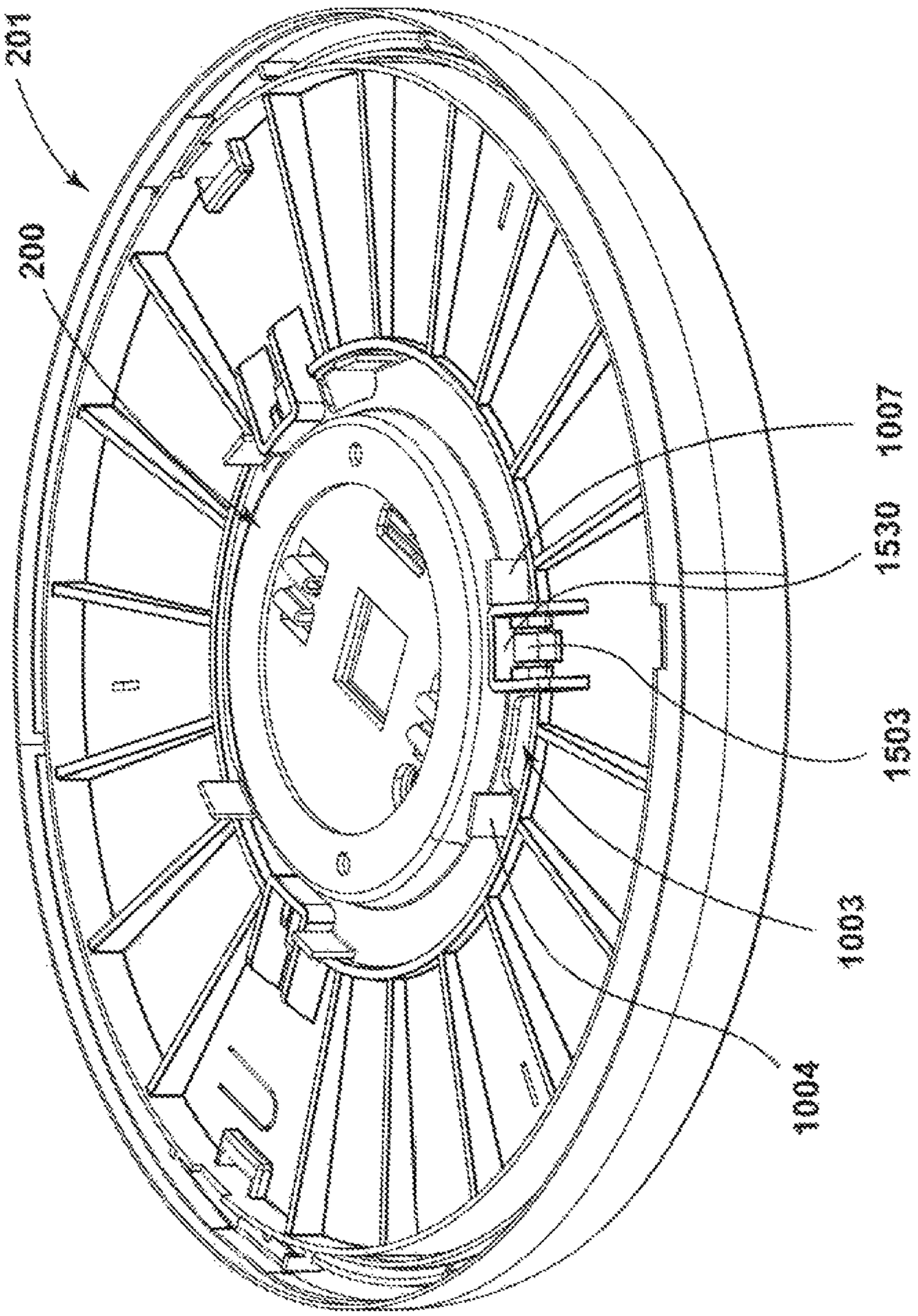

FIG. 28

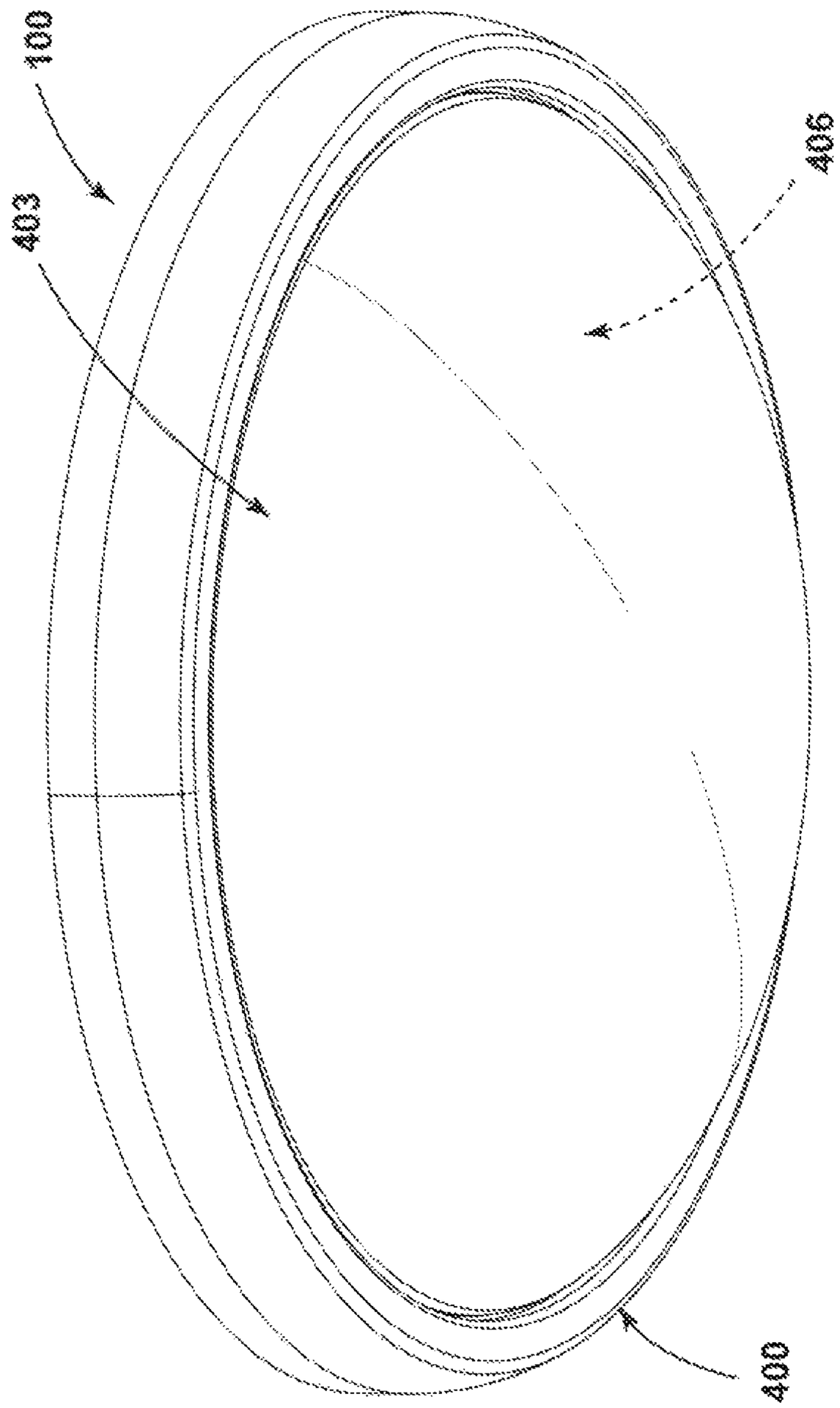

FIG. 29

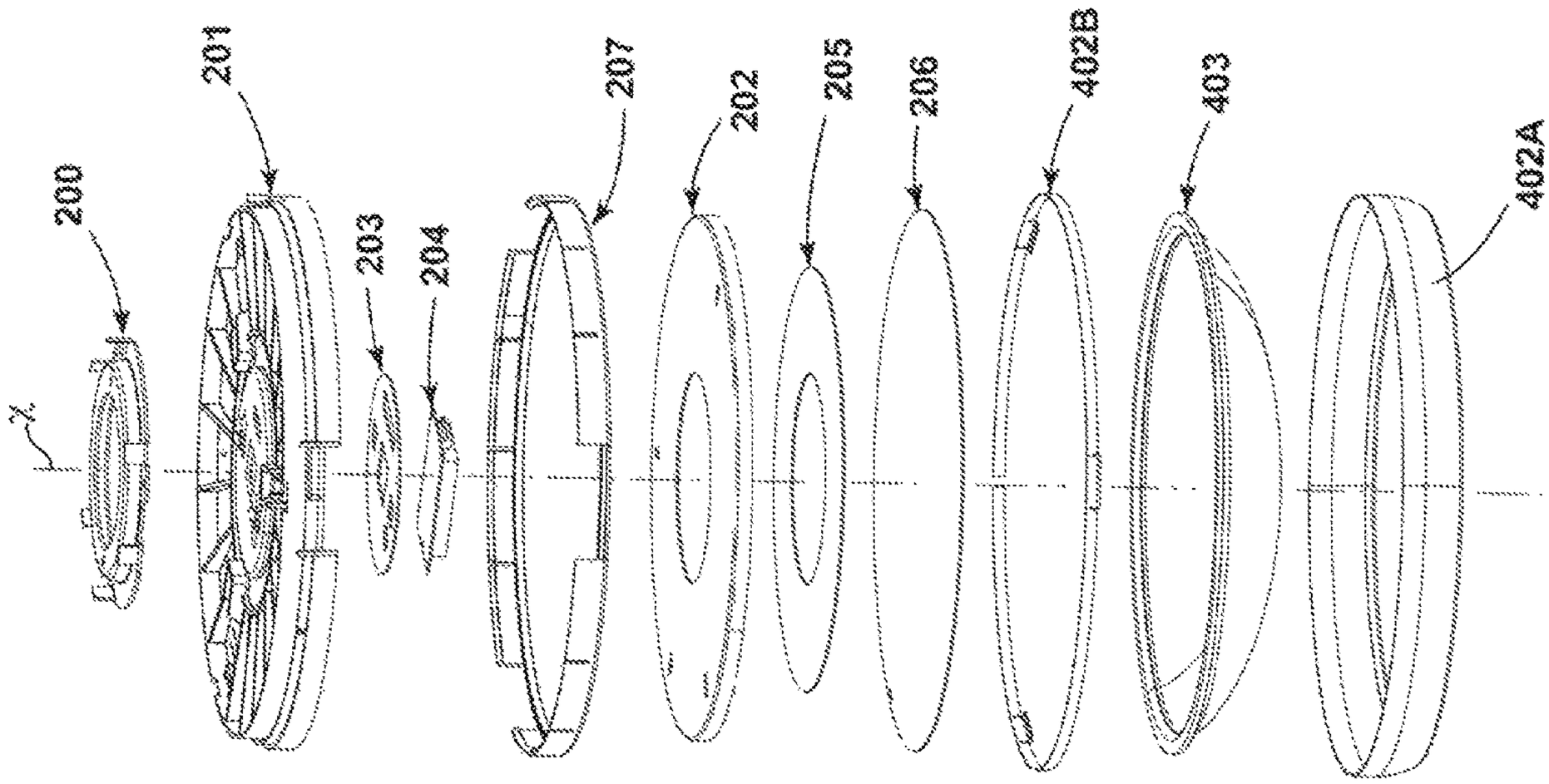

FIG. 3C

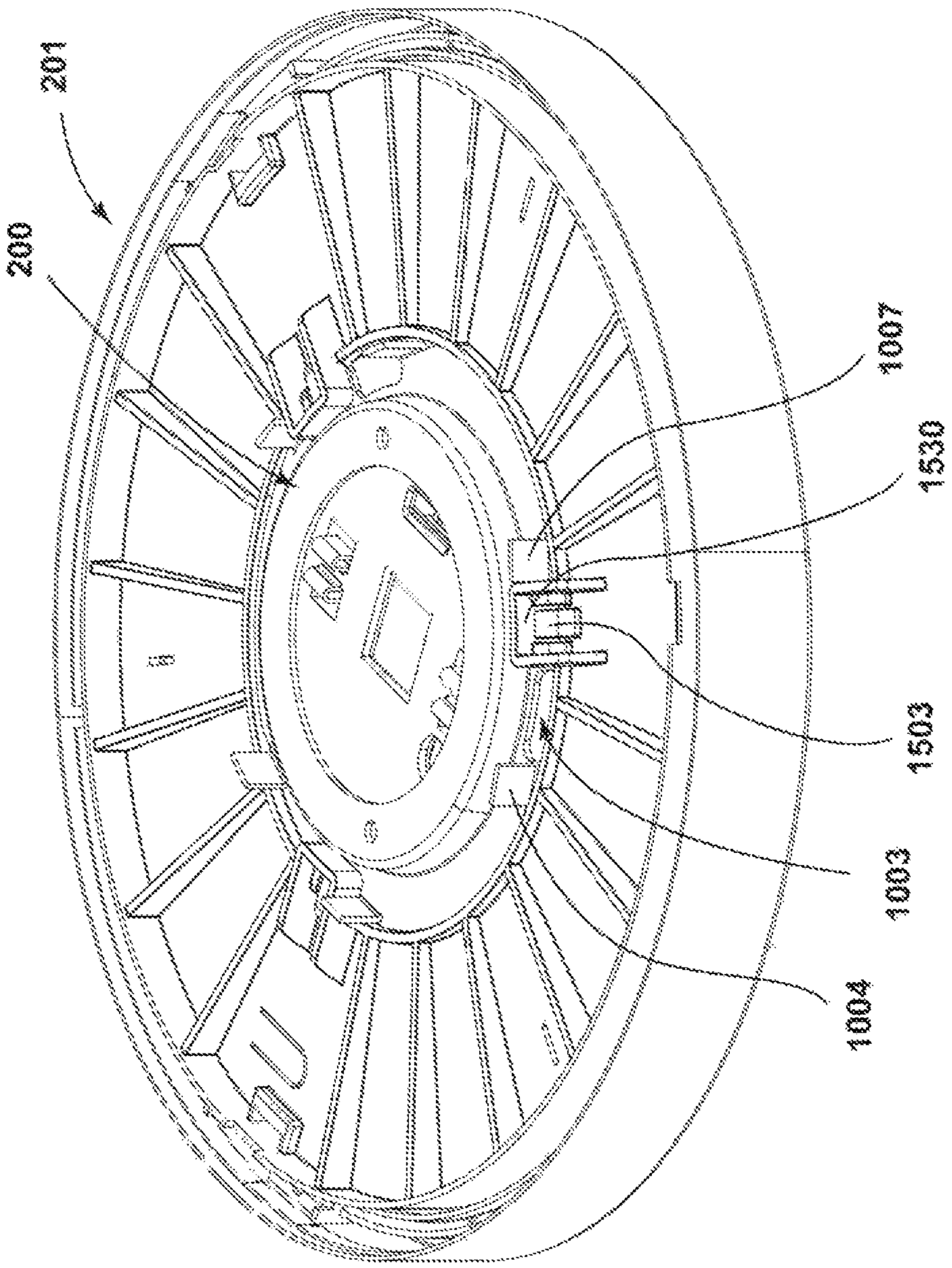

FIG. 31

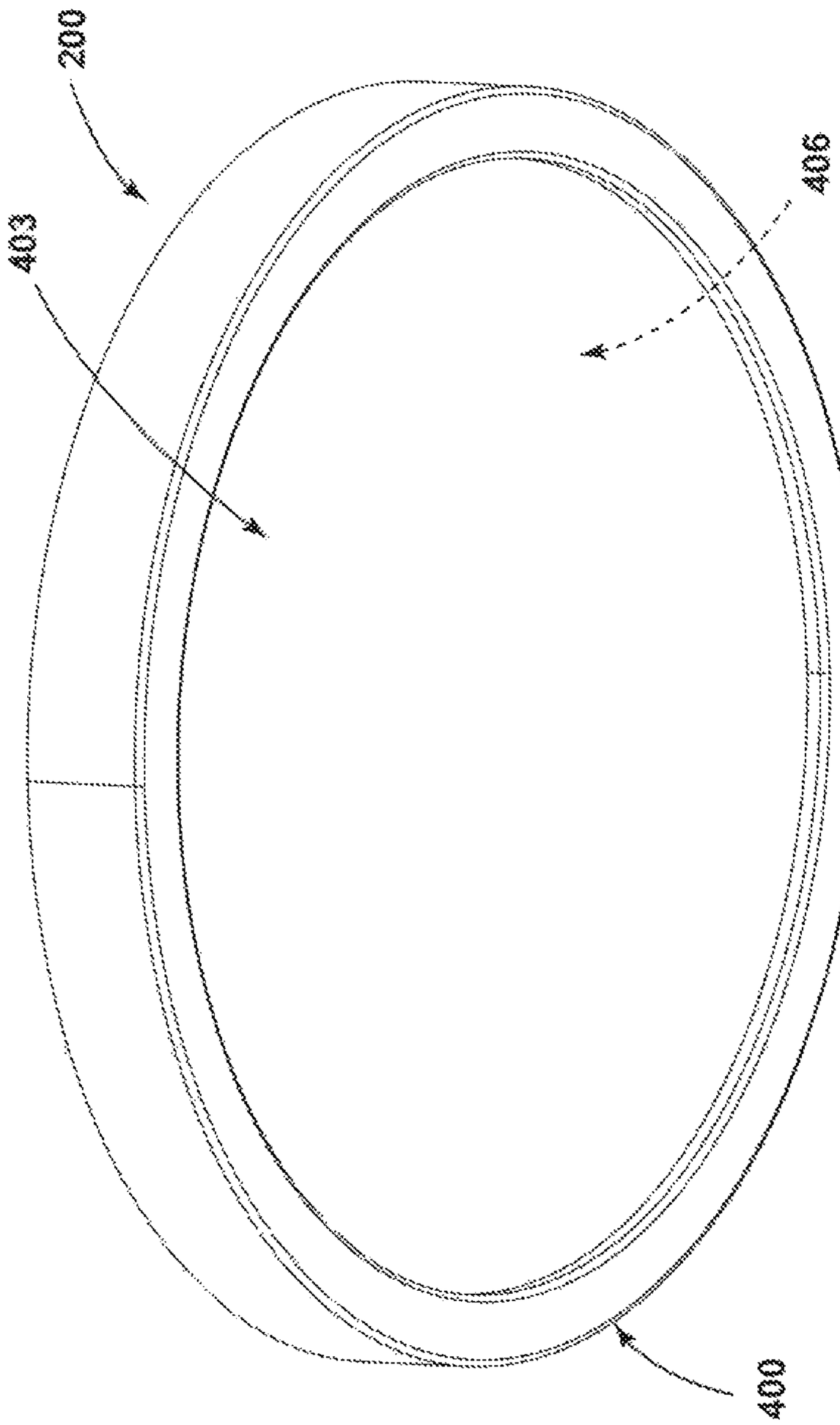

FIG. 32

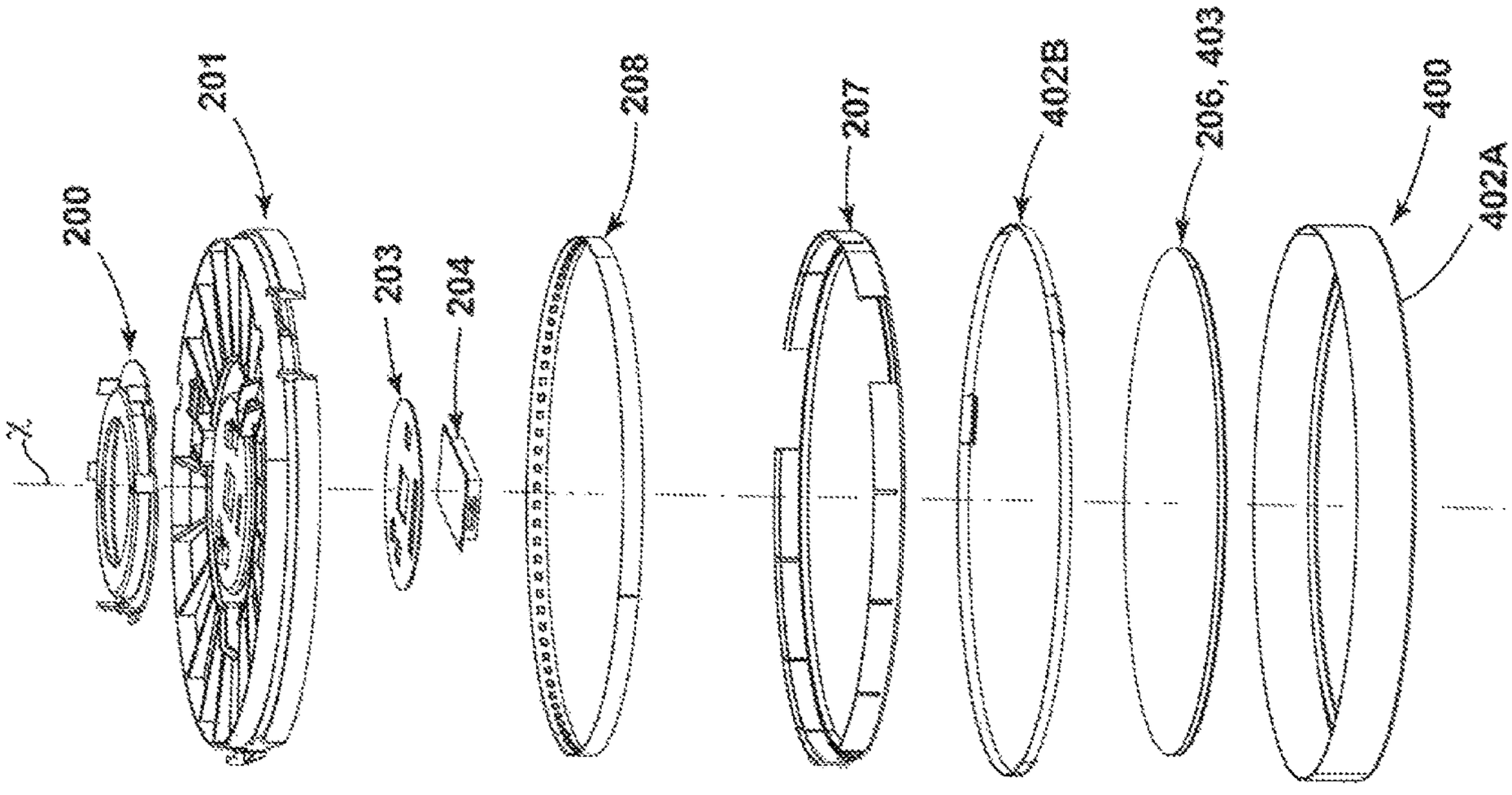

FIG. 3

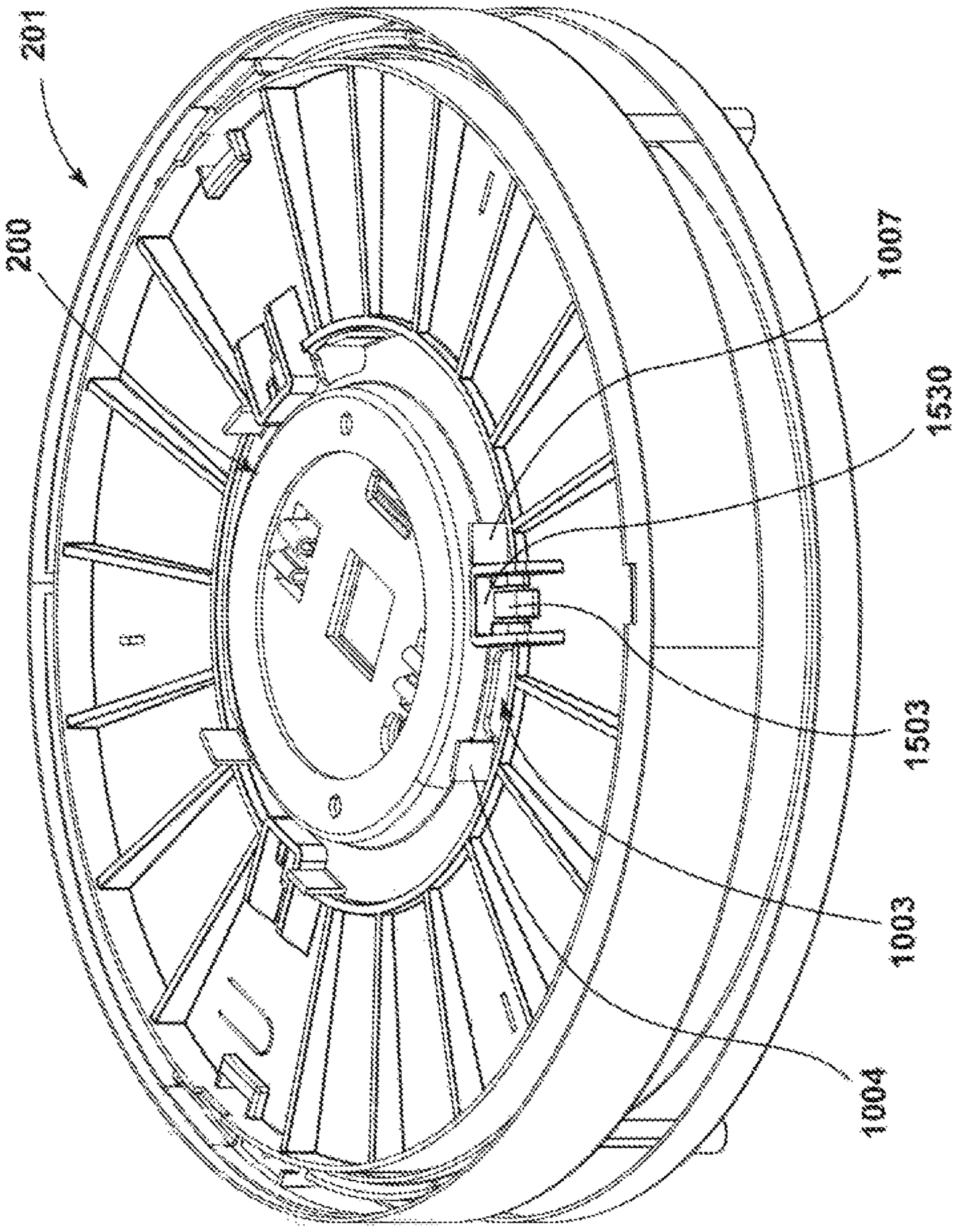

FIG. 34

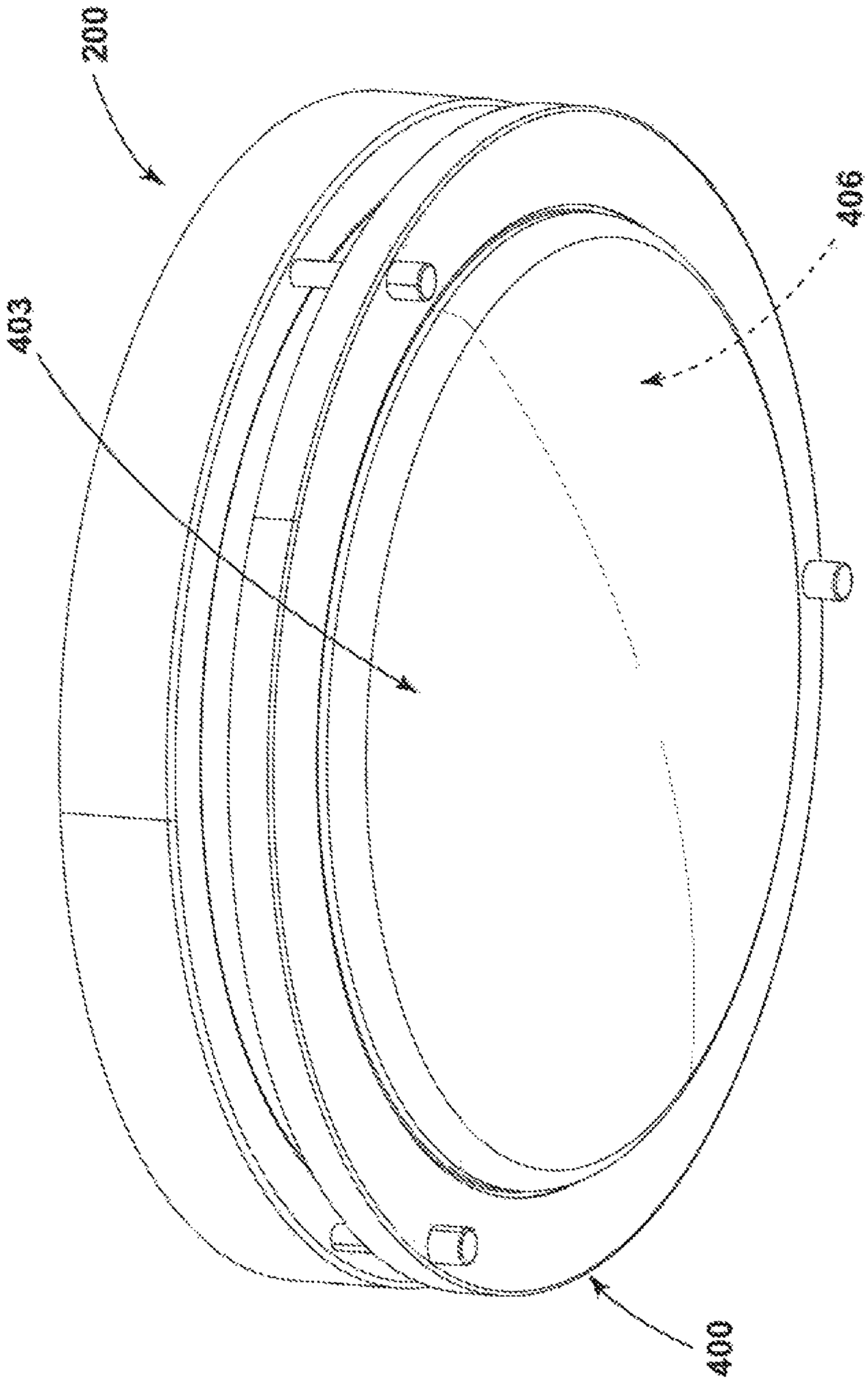

FIG. 35

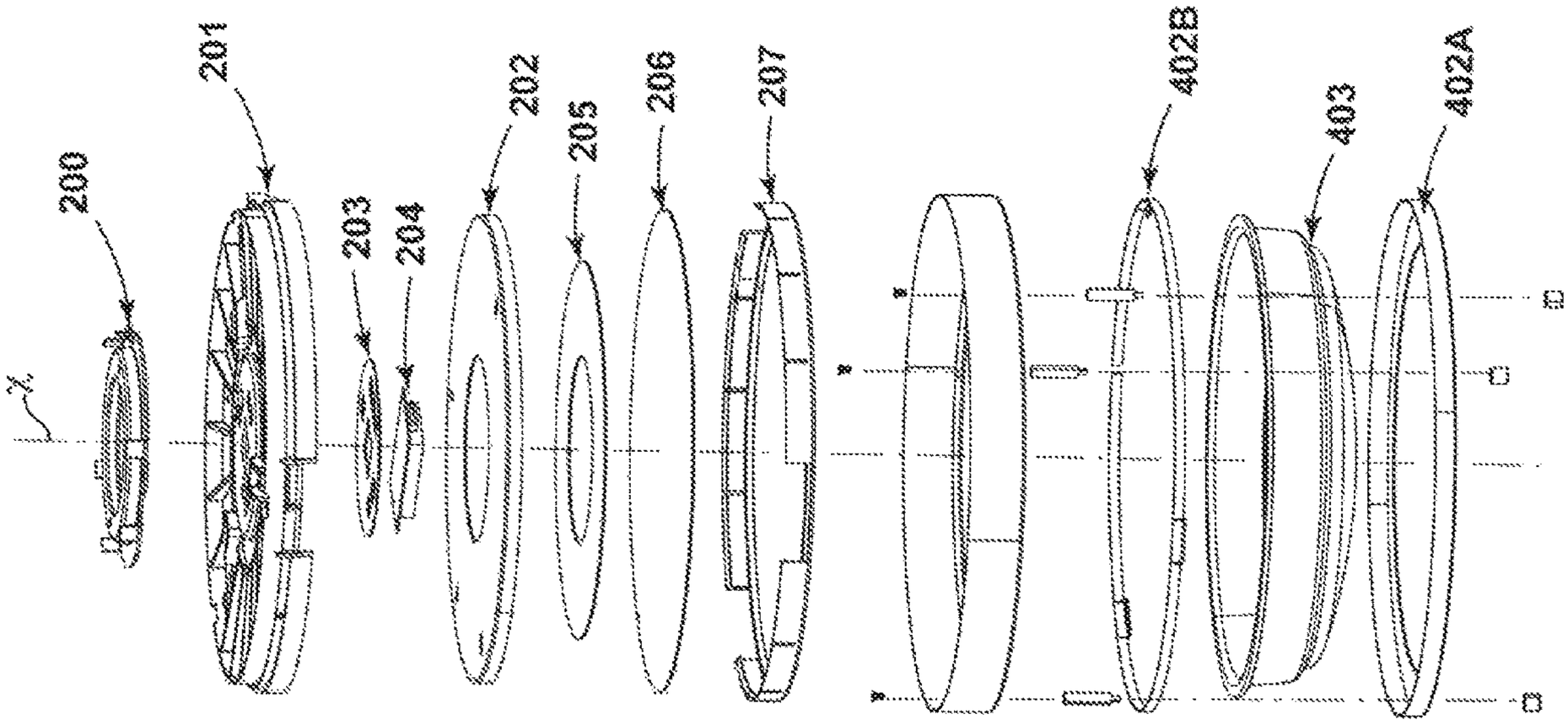

FIG. 3G

MODULAR LED LIGHT STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application No. 63/330,560 to David LaVigna et al. filed on Apr. 13, 2022 and U.S. Provisional Application No. 63/333,430 to David LaVigna et al. filed on Apr. 21, 2022, the contents of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

This invention relates to LED luminaires and, more particularly, to a luminaire having a plurality of light engines, diffusers, and décor trims assembled to a common structure.

BACKGROUND OF THE INVENTION

LED (light emitting diode) luminaires are used in lighting commercial, institutional, and residential buildings. Many are designed utilizing configurations with foundations in legacy lighting such as fluorescent and incandescent. Features of luminaires are typically fixed, non-changing, as an outcome of design and production methods and could encompass color correlated temperature (CCT) differences, external décor appearances, changes in light pattern diffusion, LED light engine assemblies (combination of system power supply and LED PCBA configurations), and lighting controls.

Current industry practice is to adapt the LED system components to a legacy or contemporary form factors, with little or no modifications available to the basic structural components of the luminaire. Further, certain aspects such as light emission direction are fixed and unalterable in any post production capacity. These limitations restrict or prohibit advantages of interchangeable components, thus increasing costs in production, assembly, and warehousing.

SUMMARY

In a first aspect, a modular luminaire assembly for use in connection with an electrical power source, and a driver operatively electrically connected to the power source. The luminaire structure comprises a universal mounting ring affixed to a recessed electrical splice compartment and mechanically connected to the electrical power source. The luminaire further comprises an inner body to which light engine, structural components, and attachment to mounting ring are facilitated. The inner body is comprised of non-conductive material.

In a second aspect, a modular luminaire assembly for use in connection with an electrical power source, and a driver operatively electrically connected to the power source. The luminaire inner body comprises locations to affix the driver assembly, index a thermal plate for the driver and a thermal pan, radial planes the index a first and a second curved LED printed circuit board assembly (PCBA), index points by which an upward directing lens is snapped in place by mechanical means, index points by which a décor bezel assembly is affixed. These said indexing points are axially distributed in a common plane of a respective component, and placed equidistant radially from each other in arrays of 2, 3, 4 or more locations.

In a third aspect, a modular luminaire assembly for use in connection with an electrical power source, and a driver operatively electrically connected to the power source. The luminaire utilizes an internal retaining ring which acts to set the depth of the light mixing chamber, and set location for the diffusers, reflectors, light guide plate, and décor diffuser in variations of the total feature and appearance by which the product may be configured in final form.

In a fourth aspect, a modular luminaire assembly for use in connection with an electrical power source, and a driver operatively electrically connected to the power source. The luminaire inner body may be utilized using one LED PCBA. Further variations may comprise two LED PCBA. These LED PCBA using a plurality of LED, may comprise a flexible substrate suitable for curving the PCBA along an axis 90 degree from the LED mounting plane, or mounting said plurality of LED in a common plane with the PCBA plane. The aspect continues in that it is not limited to using a single PCBA variation as described herein, but may comprise diverse pairings.

In a fifth aspect, a modular luminaire assembly for use in connection with an electrical power source, and a driver operatively electrically connected to the power source. A driver is mounted to a thermal plate, and located along a central axis to the luminaire and upon the inner body. The driver is not limited to configuration type (one type being an open chassis using AC to DC conversion circuits directly mounted to circuit board (AC DOB), another type being a switch mode power supply (SMPS) encased with a body). Said drivers can embody means to dim lighting output, change CCT by means of physical switches or external inputs through various means, connect to sensing devices affixed to the luminaire or driver, and interface with external input/output devices using wireless communications radio sets.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a bottom perspective view of a modular luminaire assembly, according to various examples.

FIG. **2** is a top perspective view of a modular luminaire assembly, according to various examples.

FIG. **2**A is a cross-sectional view of the modular luminaire assembly of FIG. **1** taken along line IIA-IIA.

FIG. **2**B is an enlarged partial view of section IIB of FIG. **2**A

FIG. **2**C is a first perspective cross-sectional view of the modular luminaire assembly of FIG. **2** taken along line IIC-D-IIC-D.

FIG. **2**D is a second perspective cross-sectional view of the modular luminaire assembly of FIG. **2** taken along line IIC-D-IIC-D.

FIG. **3** is an exploded view of the modular luminaire assembly of FIG. **1**.

FIG. **4** is a top perspective view of a mounting ring of a modular luminaire assembly, according to various examples.

FIG. **5** is a top perspective view of an inner housing of a modular luminaire assembly, according to various examples.

FIG. **6** is a partial bottom perspective view of the inner housing of FIG. **5** engaged with the mounting ring of FIG. **4**.

FIG. **7** is a partial cross-sectional view of the inner housing of FIG. **5** engaged with the mounting ring of FIG. **4**.

FIG. **8** is a top perspective view of the inner housing of FIG. **5** and the mounting ring of FIG. **4** in a first position.

FIG. **9** is a top perspective view of the inner housing of FIG. **5** and the mounting ring of FIG. **4** in a second position.

FIG. **10** is a partial perspective view an outer perimeter wall of the inner housing of FIG. **5**.

FIG. **11** is a bottom perspective view of a thermal plate and a driver assembly of a modular luminaire assembly, according to various examples.

FIG. **12** is a bottom perspective view of the thermal plate and the driver assembly of FIG. **11** separated from the inner housing of FIG. **5**.

FIG. **13** is a partial cross-sectional view of the thermal plate and the driver assembly of FIG. **11** coupled with the inner housing of FIG. **5**.

FIG. **14** is an exploded view of the inner housing of FIG. **5**, a thermal pan, a lighting assembly, a diffuser, and a retaining ring, according to various examples.

FIG. **15** is a bottom perspective view of the thermal pan of FIG. **14**.

FIG. **16** is a bottom perspective view of the thermal pan of FIG. **14** spaced apart from the inner housing of FIG. **14**.

FIG. **17** a bottom perspective view of the thermal pan of FIG. **14** coupled with the inner housing of FIG. **14**.

FIG. **18** is a cross-sectional view of the thermal pan and inner housing of FIG. **17**.

FIG. **19** is an exploded view of the inner housing of FIG. **5**, a diffuser, a light guide plate, and a lighting assembly, according to various examples.

FIG. **20** is a bottom perspective view of the inner housing coupled with the diffuser, the light guide plate, and the lighting assembly of FIG. **19**.

FIG. **21** is a top perspective view of a retaining ring, according to various examples.

FIG. **22** is a top perspective view of a bezel assembly, according to various examples.

FIG. **23** is a top perspective view of an outer diffuser and optional coupling assembly, according to various examples.

FIG. **24** is a partial cross-sectional view of a modular luminaire assembly, according to various examples.

FIG. **25** is a perspective cross-sectional view of the modular luminaire assembly of FIG. **24**.

FIG. **26** is a bottom perspective view of a nightlight assembly, according to various examples.

FIG. **27** is a partial cross-sectional view of the nightlight assembly of FIG. **26** coupled with the inner housing of FIG. **5**.

FIG. **28** is a top perspective view of a modular luminaire assembly, according to various examples.

FIG. **29** is a bottom perspective view of the modular luminaire assembly of FIG. **28**.

FIG. **30** is an exploded view of the modular luminaire assembly of FIG. **28**.

FIG. **31** is a top perspective view of a modular luminaire assembly, according to various examples.

FIG. **32** is a bottom perspective view of the modular luminaire assembly of FIG. **31**.

FIG. **33** is an exploded view of the modular luminaire assembly of FIG. **31**.

FIG. **34** is a top perspective view of a modular luminaire assembly, according to various examples.

FIG. **35** is a bottom perspective view of the modular luminaire assembly of FIG. **34**.

FIG. **36** is an exploded view of the modular luminaire assembly of FIG. **34**.

DETAILED DESCRIPTION OF THE INVENTION

Reference will now be made in detail to present embodiments of the invention, one or more examples of which are illustrated in the accompanying drawings. The detailed description uses numerical and letter designations to refer to features in the drawings. Like or similar designations in the drawings and description have been used to refer to like or similar parts of the invention.

As used herein, the terms "first," "second," and "third" may be used interchangeably to distinguish one component from another and are not intended to signify location or importance of the individual components. The terms "coupled," "fixed," "attached to," and the like refer to both direct coupling, fixing, or attaching, as well as indirect coupling, fixing, or attaching through one or more intermediate components or features, unless otherwise specified herein.

The singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise.

Approximating language, as used herein throughout the specification and claims, is applied to modify any quantitative representation that could permissibly vary without resulting in a change in the basic function to which it is related. Accordingly, a value modified by a term or terms, such as "about," "approximately," "generally," and "substantially," is not to be limited to the precise value specified. In at least some instances, the approximating language may correspond to the precision of an instrument for measuring the value, or the precision of the methods or apparatus for constructing or manufacturing the components and/or systems. For example, the approximating language may refer to being within a ten percent margin.

Moreover, the technology of the present application will be described with relation to exemplary embodiments. The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any embodiment described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments. Additionally, unless specifically identified otherwise, all embodiments described herein should be considered exemplary.

Here and throughout the specification and claims, range limitations are combined and interchanged, such ranges are identified and include all the sub-ranges contained therein unless context or language indicates otherwise. For example, all ranges disclosed herein are inclusive of the endpoints, and the endpoints are independently combinable with each other.

As used herein, the term "and/or," when used in a list of two or more items, means that any one of the listed items can be employed by itself, or any combination of two or more of the listed items can be employed. For example, if a composition or assembly is described as containing components A, B, and/or C, the composition or assembly can contain A alone; B alone; C alone; A and B in combination; A and C in combination; B and C in combination; or A, B, and C in combination.

The present disclosure is generally related to a modular luminaire assembly **100**. The modular luminaire assembly **100** disclosed herein is configured to allow a user to alter the appearance and performance of the luminaire assembly **100**, specifically to change to visible décor elements. It would be further useful for said structure to facilitate changes to what were previously fixed performance characteristics. It is advantageous to lower costs of production, assembly costs, and sustainability to accommodate changes in diffusion, CCT (color correlated temperature), addition of upward directed light sources, light engine types, and controls.

Referring now to FIGS. **1-3**, a modular luminaire assembly **100** is shown for use in connection with an electrical

power source and external control means (not shown). The modular luminaire assembly **100** comprises a mounting ring **200** coupled with an inner housing **201** and configured to selective couple the luminaire assembly **100** with a mounting surface **1000**. A bezel assembly **400** may be coupled with the inner housing **201** and defines an opening **500** configured at least partially receive an outer housing **403**. The outer housing **403**, the inner housing **201**, and the bezel assembly **400** are coupled to define a cavity **406**. The cavity **406** may be configured to house one or more light assemblies **205**, **208**, a thermal pan **202**, a thermal plate **203**, a power converter assembly **204**, a light guide **210**, a reflector **209**, and/or an interior diffuser **206**. In various examples, the luminaire assembly **100** may further include a nightlight assembly **300**.

As shown in FIG. **4**, the mounting ring **200** may be generally circular. However, it is contemplated that the mounting ring **200** may have other shapes without departing from the present disclosure. The mounting ring **200** may be formed of various materials, sufficient for structural and safety requirements, and may include a plurality pattern of embossed areas, tabs, and voids such as to create a pattern by which subsequent parts in the assembly **100** may be joined.

The mounting ring **200** includes a first portion **1001** extending about the circumference of the mounting ring **200** and having a base surface **1010**. The first portion **1001** may be generally planar and defines a center opening **1012**. The first portion **1001** may define one or more key hole slots **1002** configured to receive fasteners for coupling the mounting ring **200** with a mounting surface **1000** such as, for example, an electrical recess junction box (not shown) when the base surface **1010** is proximate the mounting surface **1000**. As shown in FIG. **4**, the key hole slots **1002** may be defined to be 180 degree opposite each other. It is contemplated that any number of key hole slots **1002** may be defined by the first portion **1001** without departing from the present disclosure. The key hole slots **1002** may be evenly spaced or may be unevenly spaced along the first portion **1001**.

With continue reference to FIG. **4**, the mounting ring **200** may have a second portion **1008** offset from the first portion **1001** and including a first surface **1020** and a second surface **1022**. The second portion **1008** may define one or more slots **1003** configured to align with and at least partially receive extensions **1502** of the inner housing **201**. Each slot **1003** may be defined in concert with one or more corresponding guide tabs **1004**. Each guide tab **1004** extends from the second portion **1008** of the mounting ring **200** at an angle of about 90 degrees relative to the second surface **1022** of the second portion **1008**.

A locking protrusion **1005** is positioned proximate each slot **1003** such that each locking protrusion **1005** at least partially defines the respective slot **1003**. Each locking protrusion **1005** is coplanar with the second portion **1008** and extends at least partially along the second portion **1008**. In various examples, the locking protrusions **1005** may extend radially outward from an outer edge of the second portion **1008**. Each locking protrusion **1005** defines a receiving space **1006** configured to engage with a respective protrusion **1507** of the inner housing **201**, as described in more detail elsewhere herein.

One or more stops **1007** may extend from the second portion **1008** of the mounting ring **200** at an angle of about 90 degrees relative to the second surface **1022** of the second portion **1008**. Each stop **1007** is positioned proximate a respective locking protrusion **1005** on a side of the locking protrusion **1005** opposite of the slot **1003**. In other words, the locking protrusion **1005** is positioned between the respective slot **1003** and the respective stops **1007**. As illustrated, the stop **1007** may be a tab; however, it is contemplated that any stop may be used. Each stop **1007** may be configured to be substantially parallel to a center axis x of the luminaire assembly **100** when assembled.

Referring now to FIG. **5**, the inner housing **201** is shown independent of the assembly **100**. The inner housing **201** may be generally round and may be nominally flat and is configured to define the minimum size of the luminaire assembly **100**. The inner housing **201** is formed of various materials that are electrically non-conductive, not limited to thermoset plastic, or metal. For example, the inner housing **201** may be formed of molded polymer materials. The inner housing **201** may further include a plurality of ribs **1500** extending outward from the first surface **1400**. The plurality of ribs **1500** are arrayed radially about the axial center of the inner housing **201** and extend from an inner perimeter wall **1522** to an outward to an outer perimeter wall **1520**.

The inner housing **201** includes a first surface **1400** and a second surface **1402**, the first surface **1400** opposing the second surface **1402**. A central plateau **1510** extends outward from the first surface **1400** such that the central plateau **1510** is offset from and parallel with the first surface **1400**. The central plateau **1510** may be centered on the inner housing **201** and may be generally circular. The inner perimeter wall **1522** extends circumferentially about the inner housing **201** and is spaced apart from an edge **1541** of the central plateau **1510** to define a mounting channel **1501**. In other words, the inner perimeter wall **1522** and the edge **1541** of the central plateau **1510** define the mounting channel **1501** with the central plateau **1510** defining the inner circumference of the mounting channel **1501** and the inner perimeter wall **1522** defining the outer circumference of the mounting channel **1501**. The mounting channel **1501** extends about the axial center of the inner housing **201** and is configured to at least partially receive the second portion **1008** of the mounting ring **200**.

As shown in FIGS. **5-7**, one or more locking tabs **1503** are spaced along the inner perimeter wall **1522**. The number of locking tabs **1503** may correspond to the number of locking protrusions **1005** of the mounting ring **200**. Each locking tab **1503** extends radially inward toward the edge **1541** of the central plateau **1510**. A protrusion **1507** extends substantially perpendicularly from an end of each locking tab **1503** toward the first surface **1400**. Each protrusion **1507** may be rounded and is configured to be received by a corresponding receiving space **1006** of the mounting ring **200**, as described in more detail elsewhere herein.

An extension **1502** extends at least partially about the respective locking tab **1503**. Each extension **1502** includes a lip **1530** extending into the mounting channel **1501** and substantially parallel to the first surface **1400**. The lip **1530** is spaced apart from the first surface **1400** to define a retention channel **1532** in communication with the mounting channel **1501**. In various examples, the locking tabs **1503** and the extensions **1502** may be positioned equidistant radially along the inner perimeter wall **1522** the mounting channel **1501**. In other examples, the locking tabs **1503** and extensions **1502** may be unevenly spaced about the inner perimeter wall **1522**. Each retention channel **1532** is configured to receive one of the locking protrusions **1005** of the mounting ring **200**.

As shown in FIGS. **8** and **9**, to couple the mounting ring **200** with the inner housing **201**, the extensions **1502** of the inner housing **201** are aligned with the slots **1003** of the

mounting ring **200**. The guide tabs **1004** are configured to at least partially abut the inner perimeter wall **1522** of the inner housing **201** to guide alignment of the mounting ring **200** for insertion into the mounting channel **1501**. When the mounting ring **200** is positioned within the mounting channel **1501**, the first surface **1020** of the second portion **1008** of the mounting ring **200** is at least partially in contact with the inner housing **201** and the extensions **1502** of the inner housing **201** are received by the slots **1003** (FIG. **8**). Each locking protrusion **1005** of the mounting ring **200** is aligned with a respective retention channel **1502**. The mounting ring **200** is then rotated in a first direction, as shown by arrow A, and each locking protrusion **1005** is received by the respective retention channel **1502** (FIG. **9**).

When the locking tab **1503** contacts the locking protrusion **1005**, the protrusion **1507** is biased upward until the protrusion **1507** is aligned with the receiving space **1006**. The locking tab **1503** then snap engages with the locking protrusion **1005**, as best shown in FIG. **6**. At the completion of the insertion the mounting ring **200** into the mounting channel **1501** and rotation of the mounting ring **200** relative to the inner housing **201**, each stop **1007** contacts the respective extension **1502** to prevent over rotation of the mounting ring **200** in the first direction past the point of snap engagement with the inner housing **201**. To disengage the mounting ring **200** from the inner housing **201**, the mounting ring **200** may be rotated in a second direction opposite the first direction.

Referring again to FIG. **5**, one or more pairs of bayonet snap tabs **1511** may be positioned on the central plateau **1510** of the inner housing **201**. Each pair of bayonet snap tabs **1511** is arrayed in parallel with respect to each other pair and may be located equidistantly from the axial center point. The central plateau **1510** defines a space **1534** aligned with each bayonet snap tab **1511** such that the pairs of bayonet snap tabs **1511** extend through the space **1534** and away from a second surface **1402** of the inner housing **201**. For each pair of bayonet snap tabs **1511**, each bayonet snap tab **1511** is arranged as to orient a retention barb **1512** outwardly and away from the other bayonet snap tab **1511** of the pair. Each pair of bayonet snap tabs **1511** is configured to index the orientation of the thermal plate **203** and the driver assembly **204** during installation, as described in more detail elsewhere herein.

With continued reference to FIG. **5**, a plurality of indexing locator notches **1513** may be distributed radially about the outer perimeter wall **1520** of the inner housing **201**. Each notch **1513** may extend from an edge of the outer perimeter wall **1520** toward the first surface **1400** of the inner housing **201**. In various examples, the locator notches **1513** may be configured to index the location of an optional nightlight assembly **300**, as discussed in more detail elsewhere herein.

The inner housing **201** may further define a plurality of receiving spaces **1508** proximate the outer perimeter wall **1520**. Each receiving space **1508** is aligned with a respective notch **1513**. In various examples, the receiving space **1508** may be generally rectangular and may be framed by a wall **1509** extending from the first surface **1400** of the inner housing **201**. The wall **1509** may be coupled with or integrally formed with the outer perimeter wall **1520** and may extend about three sides of the respective receiving space **1508**, two sides of the respective receiving space **1508**, or one side of the respective receiving space **1508**. Each wall **1509** may include a lip **1550** extending perpendicularly from the wall **1509** toward the center of the receiving space **1508**.

As best shown in FIG. **10**, the inner housing **201** may further include a plurality of index stops **1517**A, **1517**B positioned in pairs on the outer perimeter wall **1520**. Each index stop **1517**A, **1517**B may extend from an anterior face of the perimeter wall **1520**. The index stops **1517**A, **1517**B may be positioned as pairs such that one index stop **1517**A is on a first edge of a respective opening **1514** defined by the outer perimeter wall **1520** and the other index stop **1517**B is on an opposite edge of the respective opening **1514**. The pairs of index stops **1517**A, **1517**B and the respective openings **1514** may be arrayed equidistantly radially about an anterior face of the outer perimeter wall **1520**. Alternatively, the pairs of index stops **1517**A, **1517**B and the respective openings **1514** may be spaced unevenly about the outer perimeter wall **1520**.

The inner housing **201** may further include a plurality of indexing face frame mounting flanges **1516** extending along a portion of the circumference of the outer perimeter wall **1520**. Each mounting flange **1516** may correspond with a respective opening **1514** and pair of index stops **1517**A, **1517**B and may extend at least partially along an upper edge of the respective opening **1514** in a direction perpendicular to the respective index stops **1517**A, **1517**B. Each mounting flange **1516** may be coupled with or integrally formed with one of the index stops **1517**A, **1517**B of the respective pair of index stops. A protrusion **1507** may extend from the mounting flange **1516** in a direction parallel with the index stops **1517**A, **1517**B. A smaller insertion opening **1515** is defined between the mounting flange **1516** and the other of the index stops **1517**A, **1517**B. The smaller insertion opening **1515** is configured to at least partially receive the bezel **402** to engage with the protrusion **1507** and couple the bezel **402** with the inner housing **201**, as discussed in more detail elsewhere herein.

Referring now to FIGS. **11** and **12**, the thermal plate **203** may be assembled anteriorly to the inner housing **201** upon a plane perpendicular to the axial centerline of the luminaire assembly **100**. The thermal plate **203** may define a plurality of rectilinear openings **3501** configured to receive the bayonet snap tabs **1511** of the inner housing **201** to couple the thermal plate **203** with the inner housing **201**. When the thermal plate **203** and the driver assembly **204** are coupled with the inner housing **201**, each bayonet snap tab **1511** is placed into deflection position during insertion of the tab **1511** through the respective opening **3501** of the thermal plate **203**. After the retention barb **1512** of the tab **1511** is has passed through the respective opening **3501**, the tab **1511** is configured to return to a static position, retaining the plate **203** by interference fit, as best shown in FIG. **13**. When the bayonet snap tabs **1511** are received by the openings **3501**, the thermal plate **203** may be positioned parallel to, and, in various examples, in contact with, the second surface **1402** of the inner housing **201**.

Referring again to FIGS. **11** and **12**, the power converter supply assembly **204** may be coupled with the thermal plate **203** using screws, barbs, rivets or other coupling means. The power converter supply assembly **204** is nominally composed of a solid-state circuit and components, installed to a printed circuit board ("PCB") **4002**, by which main AC voltages are received, converted to DC, and supplied by multiple circuit channels to the LED printed circuit board assembly ("PCBA") arrays. The power converter supply assembly **204** may be covered with a non-combustible cover **4003**, which may be polymer or metal in composition. It is contemplated that embodiments of the power converter supply assembly **204** may be configured to alter the output of the LED PCBA arrays in intensity, through changes of

sinewave phases sent from the power converter supply assembly **204** to the LED PCBA **205**, or segregate amounts of output power to various parallel LED circuits upon the PCBA array using mechanical or electro-mechanical slide switches **4004**, or radio frequency means (not shown). This alteration may cause certain series of LED to illuminate at differing intensities with respect to other series being illuminated at the same time. Varying output may allow a user to operate the luminaire assembly **100** at a color correlated temperature pleasing to the user. It is further contemplated that embodiments of the power converter supply assembly **204** may include circuit and components configured to allow sensors to be added to the printed circuit board **4002**. These sensors may include, for example, occupancy sensors, or CO **2** sensors.

As shown in FIGS. **14** and **15**, the assembly **100** further includes a thermal pan **202** configured to disperse heat from a co-planarly affixed LED PCBA array **205**. In various examples, the thermal pan **202** may include a pan body **3003** defining a plurality of openings **3001**. Each of the openings **3001** may be defined by at least one edge **3006**.

As best shown in FIGS. **16** and **17**, the inner housing **201** further includes a plurality of mating cleats **1519** extending outward from the second surface **1402**. Each of the mating cleats **1519** may have a generally L-shaped cross section and may be configured to engage with the thermal pan **202**. Each of the openings **3001** of the pan body may be configured to receive a respective mating cleat **1519** of the inner housing **201**. The mating cleats **1519** of the inner housing **201** are configured to engage with the edge **3006** proximate the respective opening **3001** when the thermal pan **202** is rotated, as shown in FIGS. **16** and **17**. The engagement of the mating cleats **1519** with the edges **3006** is configured to couple the thermal pan **202** with the inner housing **201**. The inner housing **201** may further include a snap-engaging stop tab **1521** configured to snap engage with an opening **3002** of the thermal pan **202** to prevent counter rotation of the thermal pan **202** relative to the inner housing **201**, as described in more detail elsewhere herein.

As shown in FIG. **14**, the body **3003** of the thermal pan **202** may further define a central opening **3004** configured to be aligned with the central axis x of the assembly **100**. The opening **3004** is defined concentrically within the pan body **3003** of the thermal pan **202** and is configured to receive the power converter assembly **204**. This allows the thermal pan **202** to pass over the power converter supply assembly **204** during manufacturing assembly. The pan body **3003** may further define a stop receiving space **3002** configured to receive the stop tab **1521** of the inner housing **201**, as described in more detail elsewhere herein.

The thermal pan **202** may further include a perimeter flange **3005** extending about at least a portion of the circumference of the pan body **3003**. The perimeter flange **3005** extends axially from the edge of the pan body **3003** and may continuous or discontinuous. The perimeter flange **3005** is configured to act as a structural spacer for separating the LED PCBA **205** from the interior diffuser **206**. In other words, the as described in more detail elsewhere herein.

Referring still to FIG. **14**, the LED PCBA **205** may be configured as a substantially flat disc or plate aligned perpendicular to the fixture axially, and parallel with and coupled to the thermal pan **202**. The LED PCBA **205** may include a plurality of LED components interconnected electrically and configured to direct illumination perpendicularly toward the anterior of the luminaire assembly **100**. It is contemplated that LED PCBA **205** may have any shape configured to position the LED PCBA **205** in contact and/or flush with the pan body **3003** thermal pan **202**. The LED PCBA **205** may be installed symmetrically in different orientations to utilize optic orientation for diverse lighting effects.

As shown in FIGS. **16** and **17**, during assembly, the thermal pan **202** is brought into alignment with the second surface **1402** of the inner housing **201** and the plurality of openings **3001** are aligned with the respective mating cleats **1519** of the inner housing **201**. The mating cleats **1519** are inserted into the respective openings **3001**. The thermal pan **202** is rotated in a first direction (as shown by arrow B) to engage each of the mating cleats **1519** of the inner housing **201** with the edge **3006** of the respective opening **3001**. Coupling of the thermal pan **202** with the inner housing **201** is configured to subsequently couple the LED PCBA **205** with the inner housing **201**.

Once the thermal pan **202** is coupled with the inner housing **201** through the engagement of the mating cleats **1519** and the openings **3001**, the stop tab **1521** of the inner housing **201** is configured to snap engage with the stop receiving space **3002** of the thermal pan **202** (FIG. **17**). The engagement of the stop tab **1521** with the stop receiving space **3002** is configured to inhibit rotation of the thermal pan **202** in a second direction opposite. The second direction is opposite the first direction. To disengage the thermal pan **202** from the inner housing **201**, the stop tab **1521** may be configured to be selectively disengaged from the stop receiving space **3002** so that the thermal pan **202** may be rotated in the second direction.

Referring now to FIG. **18**, as previously introduced, the perimeter flange **3005** is configured to provide a structural spacer holding the PCBA **205** at a fixed distance from the interior diffuser **206**. The perimeter flange **3005** is also configured to define an optical mixing chamber **3030** depth by which the LED beam spread will create a uniformity of photons simultaneously striking the diffuser **206**. This uniformity may avoid over-lit or underlit areas of the diffuser **206**.

As shown in FIG. **18**, the LED PCBA **205** is coupled with the pan body **3003** of the thermal pan **202**. In various examples the LED PCBA **205** may be coupled with the thermal pan **202** using toolless stand offs and rivets, common to one familiar with the art of electronic assemblies. The toolless stand offs and rivets correspond to hole patterns defined by the pan body **3003** of the thermal pan **202**. When the LED PCBA **205** is coupled with the pan body **3003**, the perimeter flange **3005** extends at least partially about the LED PCBA **205**.

As previously described, in various examples, the LED PCBA **205** may be configured as a primary means of illumination. As shown in FIGS. **19** and **20**, the assembly **100** may include an LED PCBA strip **208** configured as an alternate means of illumination for the assembly **100**. It is contemplated that any combination of the LED PCBA **205**, the thermal pan **202**, and the LED PCBA strip **208** may be used without departing from the scope of the present disclosure.

The LED PCBA strip **208** may be installed radially about an inner face of the outer perimeter wall **1520** of the inner housing **201** and may extend along the outer perimeter wall **1520** in a direction substantially parallel to a center axis of the housing **201**. The LED PCBA strip **208** may be nominally longer in length than width and includes a plurality of LED components **208***a* connected by electrical circuit. In various examples, the plurality of LED components **208***a* may be affixed in a single row. Alternatively, the plurality of

LED components **208***a* may be affixed in multiple rows. The LED PCBA strip **208** may be configured to the LED emitter toward the center axis x.

When the plurality of LED components **208***a* are activated, light is radiated into an edge **211** of a light guide plate **210**. The light may be configured to be refracted 90 degrees by an etching of a surface of a light guide plate **210**. The refracted light may be directed through a diffuser **206***a* configured to act as a lens, toward an anterior face of the luminaire assembly **100**. It is contemplated that the LED PCBA strip **208** may be used in place of or in conjunction with the thermal pan **202** and LED PCBA **205** may not be not utilized. A reflector sheet **209** may be applied to the posterior plane of the light guide plate **210** to inhibit illumination loss through internal planes, more effectively reflecting the output of illumination as to increase the output of light. The advantage of the LED PCBA strip **208** is that the strip **208** is configured to allow for a lower overall product height owing to not requiring a light mixing chamber as occurring in the former means of illumination.

As shown in FIG. **21**, the assembly **100** further includes the fixture retaining ring **207**. The fixture retaining ring **207** includes a ring body **5501**. The ring body **5501**, having a posterior surface, is used to create an aperture **5500** smaller than part diameters of the outer diffuser **403** and the interior diffuser **206**, allowing the fixture retaining ring **207** to secure said diffusers **206**, **403** along the posterior surface, when fully engaged to the inner housing **201**.

A plurality of snap flanges **5503** are positioned along an outer edge of the ring body **5501** and protruding parallel to the primary axial orientation. Each of the plurality of snap flanges **5503** may define one or more blade slots **5504** extending along the axial length of the snap flange **5503**. Each snap flange **5503** may define any number of blade slots **5504**. The blade slots **5504** may be evenly or unevenly spaced along the circumferential length of the respective snap flange **5503**. The spacing of the blade slots **5504** may be configured to allow for the snap flanges **5503** to flex when the fixture retaining ring **207** is engaged with the inner housing **201** during assembly.

The plurality of snap flanges **5503** may further be spaced apart to define a plurality of voids **5502**. The plurality of voids **5502** may be configured to act as first indexing locators to align the fixture retaining ring **507** with the inner housing **201** during assembly. The plurality of voids **5502** may also be configured to at least partially receive the bezel assembly **400**, as described in more detail elsewhere herein.

As shown in FIG. **22**, the assembly **100** may further include a bezel assembly **400** including an outer bezel **402**A coupled with an internal bezel metal ring **402**B. The appearance of the bezel assembly **400** may be changed by changing the appearance of the outer bezel **402**A. The outer bezel **402**A may have a nominally a circular shape with an anterior face **6004**. The anterior face **6004** of the outer bezel **402**A may be positioned to cover the space between the outer diffuser **403** and the mounting surface **1000**. The outer bezel **402**A further includes a posterior edge **6005**. The internal bezel metal ring **402**B may be configured as a circular band including a surface **6002** axially parallel to the center assembled axis of the assembly **100**. A plurality of décor bezel mounting tabs **6003** may be arrayed equidistantly radially about the bezel ring **402**B. The décor bezel mounting tabs **6003** extend at right angle to the circular band **6002** toward the center axis. Each tab **6003** features an indexing notch **6006** centered on an edge of the tab **6003**.

Referring now to FIG. **23**, the assembly **100** further includes the outer diffuser **403** and a coupling assembly **404**. The outer diffuser **403** may be embodied in various forms, colors and textural effects as to create a desirable disbursement of light and appearance of the translucent membrane. The coupling assembly **404** may be affixed in certain embodiments as a desirable accent element, the mounting of which may be mechanical fit through an opening in the décor diffuser **403**, secured by a locking hex nut fastener, or by other means to one schooled in such art. In various examples, the outer diffuser **403** may further include a reflector, a light guide plate, and/or a lens. In other examples, the lens **206** may be configured to act as a outer diffuser **403** to reduce overall assembly height by use of the alternate emitter embodiment of edge lit LED PCBA **208** as room side lighting.

As shown in FIG. **24**, when the retaining ring **207** is coupled with the inner housing **201**, the snap flanges **5503** of the retaining ring **207** engage the inner housing **201** by interference fit upon a circumferential shoulder **5505** of the inner housing **201**. The bezel assembly **400** may then be coupled with the inner housing **201** to extend over the retaining ring **207**. As shown in FIG. **25**, the plurality of voids **5502** which create a clear means to raise the décor bezel mounting tab **6003** to engage with a respective protrusion **1507** of the inner housing **201**. During assembly, the décor bezel mounting tab **6003** is indexed to align with both lower insertion opening **1514** and upper insertion opening **1515** of the inner housing **201**. The mounting tab **603** is brought into elevation to permit rotation to align the mounting tab **6003** upon the inner housing **201** face frame mounting flange **1516**, and register the notch **6006** in mounting tab **6003** with the respective protrusion **1507** on the face frame mounting flange **1516**.

Referring now to FIG. **26**, in various examples, the assembly **100** may include a nightlight assembly **300** including a refracting light guide lens **302** and an LED PCBA strip **301**. The nightlight assembly **300** is configured to provide a secondary illumination radiation pattern. It will be understood that the assembly **100** may exclude the nightlight assembly **300** without departing from the scope of the present disclosure. As shown in FIG. **25**, where a nightlight assembly **300** is included, the outer bezel **402**A includes a posterior edge **6005** that abuts and lays tangent to an outer ridge **2001** of the nightlight lens **302**, which allows for illumination while covering the internal assembly of parts.

The refracting light guide lens **302** is nominally a circular component, having at least an outer ridge **2001** and an inner ridge **2002**, positioned along an anterior side of the lens **302**. As shown in FIG. **27**, the inner ridge **2002** includes a surface **2003** oriented substantially parallel to the outer perimeter wall **1520** of the inner housing **201**. The surface **6003** is spaced apart from the outer perimeter wall **1520** to define a channel **2008** configured to receive the LED PCBA strip **301**. This ridge **2002** is configured to provide refraction to allow photons to be transmitted through the refracting light guide lens **302** and exiting through an outer surface **2009** of the outer ridge **2001**.

The LED PCBA strip includes a plurality of LED lighting assembly **2004** arranged on an LED PCBA **2005**. When assembled, the surface **2003** may be substantially parallel with and/or in contact with the LED lighting assemblies **2004** of the LED PCBA **2005**. The refracting light guide lens **302** may include a plurality of bayonet style mounting barbs **2006** positioned circumferentially along the length of the lens **302**. The barbs **2006** are arranged to align with voids **1513** in the inner housing **201**. When assembled, each barb **2006** is configured to be at least partially received by the

respective void **1508**. A tooth **2007** of each bayonet barb **2006** is configured to engage with the lip **1550** of the wall **1509**.

Referring now to FIGS. **28-36**, various exemplary shapes for the various components are shown. The same or similar numbers are used throughout to indicate the corresponding parts for each exemplary shape.

What is claimed is:

1. A modular luminaire assembly comprising:

a mounting ring configured to be selectively coupled with a mounting surface;

an inner housing defining a channel configured to receive the mounting ring, wherein the mounting ring is configured to be selectively coupled with the inner housing;

a lighting assembly;

one or more diffusers configured to direct light from the lighting assembly;

a retaining ring including a ring body defining an opening and a plurality of flanges configured to snap engage with the inner housing, wherein the ring body is configured to at least partially support the one or more diffusers and the lighting assembly; and

a thermal pan having a perimeter flange and a pan body defining a plurality of openings, each opening at least partially defined by a linear edge,

wherein the inner housing includes a plurality of mating cleats configured to be received by the plurality of openings, and further wherein each mating cleat configured to be received by a respective opening and engage with the respective linear edge to couple the thermal pan with the inner housing.

2. The modular luminaire assembly of claim **1**, wherein the one or more diffusers includes an interior diffuser spaced apart from the pan body of the thermal pan to define a mixing chamber.

3. The modular luminaire assembly of claim **1**, wherein the lighting assembly includes a planar LED PCBA.

4. The modular luminaire assembly of claim **1**, further comprising:

a diffuser configured as a lens; and a light guide plate having an edge configured to receive light from the lighting assembly and redirect the light outward from the light guide plate, wherein the diffuser and the light guide plate are at least partially supported by the retaining ring.

5. The modular luminaire of claim **1**, wherein the inner housing includes an outer perimeter wall, an inner perimeter wall, and a central plateau having an edge, and further wherein the outer perimeter wall, the inner perimeter wall, and the central plateau are configured to guide coupling of the mounting ring, the lighting assembly, the one or more diffusers, and the retaining ring.

6. The modular luminaire assembly of claim **1**, wherein the inner housing includes an extension surrounding a locking tab and defining a receiving slot, and further wherein the mounting ring includes a locking protrusion configured to be received by the receiving slot by rotation of the mounting ring within the mounting channel in a single axis radially.

7. The modular luminaire assembly of claim **1**, further comprising:

a bezel assembly positioned exterior of the inner housing and including an inner ring having a plurality of mounting tabs configured to be rotated radially about a single axis to engage the inner housing.

8. The modular luminaire assembly of claim **1**, further comprising:

a nightlight assembly including a lens configured to snap engage with the inner housing to define a channel and a plurality of LEDs positioned within the channel, wherein the lens is configured to direct light from the plurality of LEDs outward from the inner housing.

9. The modular luminaire assembly of claim **1**, wherein the one or more diffusers includes an outer diffuser, said outer diffuser defining a cavity configured to house the lighting assembly.

10. The modular luminaire assembly of claim **1**, further comprising:

a bezel assembly positioned exterior of the inner housing and including an inner ring having a plurality of mounting tabs configured to be rotated radially about a single axis to engage the inner housing.

11. The modular luminaire assembly of claim **4**, wherein the lighting assembly includes an LED PCBA strip.

12. A modular luminaire assembly comprising:

a mounting ring;

an inner housing including a plurality of tabs and notches configured to be rotationally engaged with the mounting ring and further including a plurality of protrusions;

a bezel assembly positioned exterior of the inner housing and including an inner ring having a plurality of mounting tabs each defining a notch, wherein the bezel assembly is configured to be rotated radially about a single axis to engage each of the plurality of protrusions with the respective notch;

a lighting assembly coupled with the inner housing; and

at least one diffuser position to direct light from the lighting assembly.

13. The modular luminaire assembly of claim **12**, wherein the inner housing includes an outer perimeter wall configured to support the lighting assembly along either an interior plane of the outer perimeter wall or an exterior plane of the outer perimeter wall.

14. The modular luminaire assembly of claim **12**, wherein the lighting assembly is configured to be controlled by a first trace control channel.

15. The modular luminaire assembly of claim **12**, further comprising:

a nightlight assembly including a lens configured to snap engage with the inner housing to define a channel and a plurality of LEDs positioned within the channel, wherein the lens is configured to direct light from the plurality of LEDs outward from the inner housing.

16. The modular luminaire assembly of claim **15**, wherein the plurality of LEDs of the nightlight assembly illumination are configured to be controlled using a second trace control channel.

17. A modular luminaire assembly comprising:

a mounting ring configured to be selectively coupled with a mounting surface and including a locking protrusion;

an inner housing defining a channel configured to receive the mounting ring and including an extension surrounding a locking tab and defining a receiving slot, wherein the mounting ring is configured to be selectively coupled with the inner housing, and further wherein the locking protrusion configured to be received by the receiving slot by rotation of the mounting ring within the mounting channel in a single axis radially;

a lighting assembly;

one or more diffusers configured to direct light from the lighting assembly;

a retaining ring including a ring body defining an opening and a plurality of flanges configured to snap engage with the inner housing, wherein the ring body is configured to at least partially support the one or more diffusers and the lighting assembly.

18. The modular luminaire assembly of claim **17**, further comprising:

a nightlight assembly including a lens configured to snap engage with the inner housing to define a channel and a plurality of LEDs positioned within the channel, wherein the lens is configured to direct light from the plurality of LEDs outward from the inner housing.

19. The modular luminaire assembly of claim **17**, further comprising:

a thermal pan having a perimeter flange and a pan body defining a plurality of openings, each opening at least partially defined by a linear edge,

wherein the inner housing includes a plurality of mating cleats configured to be received by the plurality of openings, and further wherein each mating cleat configured to be received by a respective opening and engage with the respective linear edge to couple the thermal pan with the inner housing.

20. The modular luminaire assembly of claim **17**, wherein the one or more diffusers contains one of:

an outer diffuser defining a cavity configured to house the lighting assembly, and

an interior diffuser spaced apart from a thermal pan to define a mixing chamber.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 11,976,802 B2
APPLICATION NO. : 17/948992
DATED : May 7, 2024
INVENTOR(S) : David LaVigna, Matt Willard and Tim Norton

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

Claim 12, Line 13: Change “position” to --positioned--

Signed and Sealed this
Twenty-ninth Day of October, 2024

Katherine Kelly Vidal

Katherine Kelly Vidal
Director of the United States Patent and Trademark Office